THE ENGINEER.

The Shipping, Engineering and Machinery Exhibition at Olympia.

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THE Exhibition which was opened at Olympia yesterday and which will remain open until the 28th of this month covers a very wide range of interests in the shipping, engineering, and machinery worlds. Under the general managership of Mr. F. W. Bridges, it is being supported by the British Engineers' Association, the Society of Motor Manufacturers and Traders, and the British Marine Oil Engine Manufacturers' Association. It is the ninth exhibition of its series. The first was held in 1906, the second in 1907, and the third in 1910. Since 1919 the Exhibition has been held at regular two-yearly intervals. Since 1910 the British machine tool industry, for reasons which are well understood, has been practically unrepresented at the Exhibitions. It is a notable omission, but it is now quite evident that, without machine tools, the fields of engineering interest on which the Exhibition draws are amply sufficient to fill the enlarged Olympia with a collection of equipment, machines and accessories, of home and foreign production, which deserves the attention of all connected with our profession and its various branches.

In this Supplement we give some account of certain of the exhibits which the visitor to Olympia during the coming fortnight will find staged for his instruction and inspection. As usual, it has not been possible to include in this Supplement a description of all the principal items on show. Other exhibits will be dealt with in our ordinary columns.

BARR AND STROUD, LTD.

The main exhibit on the stand of Barr and Stroud, Ltd., of Anniesland, Glasgow, consists of a number of rangefinders, specially designed for navigational use. It is now recognised that when a ship is approaching a dangerous object a knowledge of the range of that object is usually of more importance than its bearing. The rangefinder enables the navigating officer to measure distance directly by means of a single observation, and rangefinders are now fast becoming an integral part of the navigating equipment of large British and foreign passenger liners and fast cargo ships. For special ships, such as cable vessels, they are considered practically indispensable. In the accompanying engravings—Figs. 1 and 2—we show the standard 4ft. 6in. base rangefinder, mounted on a deck pedestal. The view to the left shows the observer's side of the instrument, while in that to the right the window side of the instrument is shown.

The Barr and Stroud rangefinder may be regarded as two telescopes or two horizontal periscopes, fixed in a common frame with the two objectives mounted one at each end of the frame, and with a single common eyepiece at the centre. Suitable reflectors in the form of pentagonal prisms are provided beyond the objectives to direct the beams of light along the frame toward the eyepieces. The distance between the centres of these two reflectors is the "base length" of the rangefinder.

The arrangement is such that the combined telescopes may be simultaneously directed and focussed on the same target. The rangefinder forms, in effect, the base of a triangle, having at its vertex the object whose range is to be measured.

It is well known that if the length of one side and the value of any two angles of a triangle are known, the lengths of the other two sides can then be determined. In the diagram reproduced to the left in Fig. 3, the known base length of the rangefinder is shown as the side A B of the triangle. One of the base angles, say, that at A, remains constant at 90 deg. The "parallax angle" at P is measured by moving a "deflecting prism," to which the range scale is connected, along the right half of the rangefinder. The greater the distance of the object, then the smaller will be the parallax angle. The position of the deflecting prism thus gives a measure of the range. Hence the scale, the movement of which corresponds to that of the deflecting prism, may be graduated in yards or any other desired unit of length. Usually it is engraved on a spiral of about 24in. in length, with numbered graduations. The lowest range is about 500 yards and the highest range 25,000 yards.

The drawing reproduced to the right in Fig. 3 shows diagrammatically the essential instrument parts.

The beam of light 1 from P, passing through the objective O, after striking the end reflector R A forms an image of the object on the separating line at a of the centre prism combination C P, which has an eyepiece E.

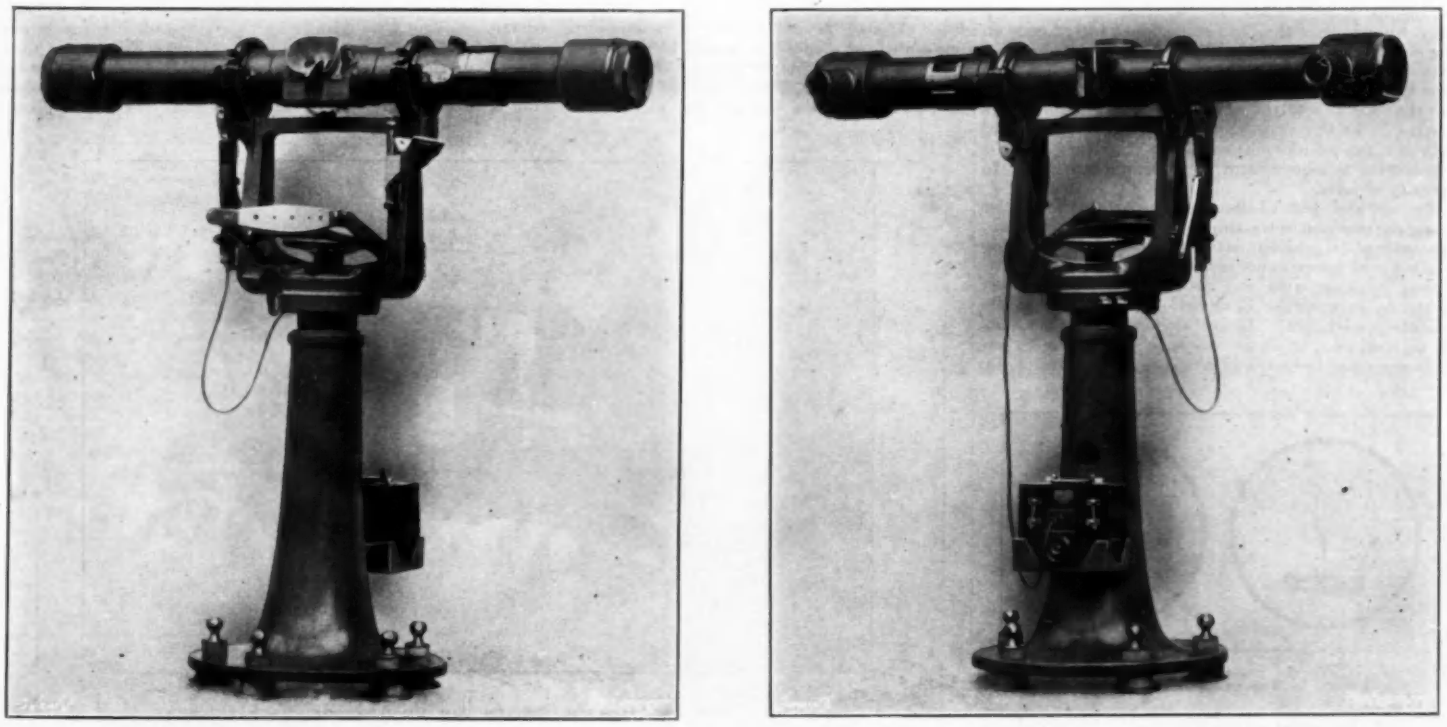
The beam 2 incident on the right end reflector R B would form an image at b if the movable prism D were absent. This prism, however, when suitably moved by the working head deflects the beam so that the image formed coincides with the left-hand image at a. The nearer the object, and consequently the smaller the inclination of the beam 2 to the base A B, the farther must the prism D be moved towards B to maintain this coincidence of the images. Thus the position of the deflecting prism D is a measure of the range, and the scale S connected to D can therefore be graduated to read the range.

On looking into the right eyepiece of the rangefinder, two partial images of the object are seen, one above the other, separated by a fine horizontal line. These images before adjustment will probably be found displaced relatively to one another along the separating line, as indicated to the left-hand in Fig. 4.

By rotating the "working head," the images are brought into exact alignment, or coincidence, as shown in the right-hand view of the same engraving. When this is done, the range of the object in yards, metres, cables, or other unit may then be read in the field of the left eyepiece. Thus, the operation of determining distance by means of the rangefinder is extremely simple, and can be performed in a few seconds.

It may be noted that several features have been adopted in the design which assist the operator in making his observation. The right eyepiece for viewing the range field is provided with a focussing lever and a similar fitting is furnished on the left eyepiece, in which the scale is observed. The two eyepieces are so arranged that the rangetaker assumes a comfortable position, looking downward into the instrument at an angle of about 45 deg. A rubber facepiece is provided around the two eyepieces in order to protect the eyes of the observer from wind and stray light. A finder eyepiece, with a focussing arrangement, is fitted immediately below the right eyepiece, so that the observer can look vertically downward into it.

For night work the scale is illuminated by small lamps controlled by a switch on the rangefinder, the current being supplied by a battery attached to the pedestal and shown in Figs. 1 and 2. For night observations an astigmatiser is attached which can



FIGS. 1 AND 2—RANGEFINDER FOR A MERCANTILE VESSEL—BARR AND STROUD

be operated by means of a slide on the underside of the tube to the right-hand of the observer. The insertion of the astigmatiser causes a point of light to appear as a vertical stretch, and with it the instrument may be employed to check its own adjustment by the observations of a bright star, or the moon if it is visible. Near to the extreme high-range end of the rangefinder scale there is a star engraved, which should be the exact reading obtained when the distance, namely, "infinity" of any celestial body is measured. Means are provided for making a correction if necessary, and when the rangefinder is thus corrected for infinity it is then correct for all ranges.

Some of the uses of the rangefinder in navigation are described in what follows:—Without the rangefinder the usual method of determining the distance of an object is to take a bearing and after a certain lapse of time to take a second bearing. These bearings are then plotted on the chart, and the ship's course and the distance run are then fitted between them to form the base of a triangle. The course and distance made good by the ship over the ground cannot, however, be accurately determined, owing to drift, due to tide, wind, and sea, so that at best this method

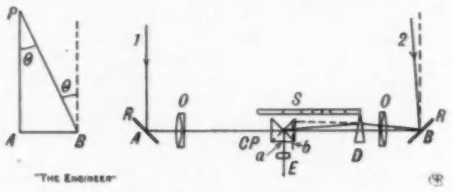


FIG. 3—PRINCIPLE OF RANGEFINDER

is merely an approximation. Also the ship may be approaching the danger while waiting for the second bearing to be taken. It will, however, be apparent that if a compass bearing of a known object be taken—as, for instance, a lighthouse, the position of the ship may, by means of the rangefinder, be fixed at once on the chart. The ship's position can also be determined by using the rangefinder to measure the distance from two known objects, and sweeping off the two circles on the chart. Their intersection gives the ship's position. In this respect it should be borne in mind that the rangefinder, especially in its larger sizes, is a powerful telescope, and it helps the navigator to identify objects.

The set and drift of the tide may also be found by fixing the position of the ship by a rangefinder position, estimating its position after a given time from log reading and compass course, and comparing this estimated position with the actual position as determined by rangefinder observation at the end of the predetermined run. Again, sextant angle methods of determining off-shore distance are liable to inaccuracies due to errors in estimating the state of the

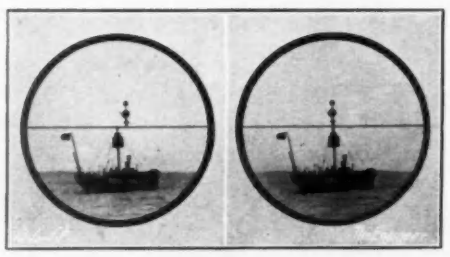


FIG. 4—RANGEFINDER IMAGES

tide and the height of the observer's eye above sea level. They demand, too, that the height of the shore object be known. The rangefinder, the makers point out, is independent of tide, height of eye, or height of object. During temporary lifting of fog, a glimpse may be caught of a light or mark. The rangefinder will measure its distance in a few seconds. At night, the rangefinder will measure the distance of a light, whether fixed or moving. The readings are independent of atmospheric conditions. A distant light can be distinguished at once from a star on the horizon. Again, when entering a harbour, continuous readings may be taken of the distance from points on shore or from neighbouring ships, and when mooring it can be found at once whether there is sufficient room for the ship to swing. The range of visibility—a matter of great importance in hazy weather and one almost impossible to estimate even approximately—can be determined easily by noting the range of a barrel or other object which has been thrown overboard and which is just disappearing in the haze. At night this can also be done by noting the "disappearing" range of a flare or other light.

The rangefinder may be used in conjunction with the sextant when determining the position of the ship by observation on celestial objects. It sometimes happens that a clear horizon is not available, owing to the interference of land. Usually in such cases the angle between the celestial object and the shore line is measured and an allowance made for the "dip." The rangefinder gives the distance to the shore and allows the "dip" correction to be made with great accuracy. A farther development of this method for use when no land is in sight is described in a pamphlet on navigational rangefinders, prepared by Barr and Stroud, Ltd.

The instrument of 4ft. 6in. base, illustrated in Figs. 1 and 2, will measure distance to within one-eighth of a cable, or about 76ft., at 2 sea miles; one-fourth of a cable, or about 152ft., at 3 sea miles; one-half of a cable, 304ft., at 4 sea miles; or 1 cable, or 608ft., at 6 sea miles. The same instrument is also made in two other base lengths of 2 m. and 9ft. respectively.

The rangefinder we have described is not a new invention, but is a robust and well-tried instrument, which has been used for over forty years for naval and army work. Other types of instruments shown are arranged for deck mounting or a light tripod stand, also for deck, rail and belt mounting with smaller base lengths, and several instruments of these different patterns have been recently supplied to oil tankers and yachts. Barr and Stroud are also exhibiting a selection of binoculars and cinematograph projector instruments.

LACY-HULBERT AND CO., LTD.

On the stand of Lacy-Hulbert and Co., Ltd., of Boreas Works, Beddington, near Croydon, there is shown a wide range of air compressing machinery and compressed air tools. An integral part of most of the machines on view is the "Boreas" patented high-speed air compressor, sections through which are reproduced in Fig. 5. The design has been specially adapted for high-speed work, and it permits the use of directly coupled petrol and paraffin engines or electric motors running at from 1200 to 1500 r.p.m. The example shown in Fig. 5 is a 120 mm. bore machine with a stroke of 140 mm., which, when running at a speed of 1000 r.p.m. has an actual output of 60 cubic feet of free air per minute, delivered at a pressure of 100 lb. per square inch. This design of machine is constructed in a series of standard sizes, with outputs varying from 1 cubic foot up to 100 cubic feet of air per minute, delivered at pressures

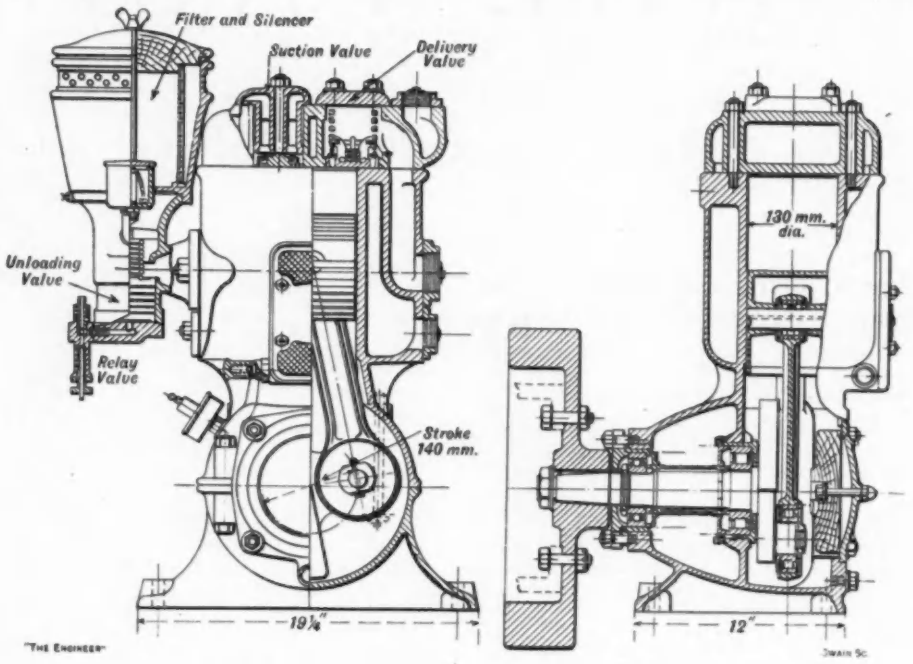


FIG. 5—HIGH-SPEED AIR COMPRESSOR—LACY-HULBERT

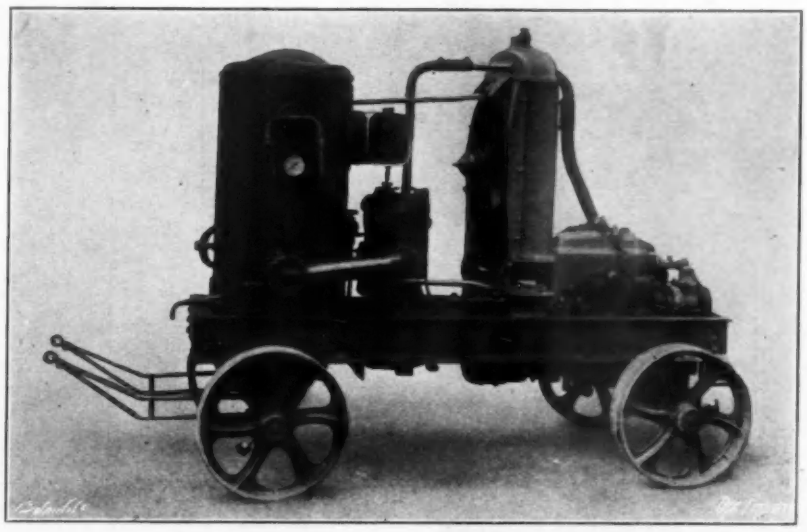


FIG. 6—PORTABLE PETROL-DRIVEN AIR COMPRESSOR—LACY-HULBERT

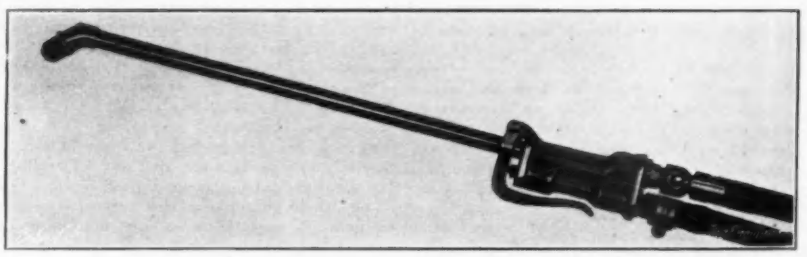


FIG. 7—PARAFFIN SPRAYING GUN—LACY-HULBERT

up to 150 lb. per square inch. Crank case compression is used to supercharge the cylinder at the end of its suction stroke, with a correspondingly high volumetric efficiency. Aluminium pistons and light stamped steel connecting-rods are employed with roller type large and small end bearings, and similar bearings for the crank shaft.

As our illustration indicates, a filter is attached to the air inlet, which is also fitted with a syphon wick feed working under suction pressure. The suction and delivery valves are neatly arranged in the cylinder head, and they are so designed that they can be removed individually without disturbing any of the pipe connections. An automatic unloading

FIG. 8—PORTABLE ELECTRICALLY-DRIVEN COMPRESSOR—LACY-HULBERT

valve operated by a small relay valve forms an integral part of the air inlet fitting. Fig. 8 shows a portable electrically driven air compressing plant, which has been specially designed for garage use. The small air compressor, which is hopper cooled by water and is automatically lubricated, is attached to a 1 horse-power motor, the whole unit, along with the automatic switch, being mounted on the top of the air receiver. This is a riveted vessel, fitted with the usual safety valve gauge, check valve, drain cock, and inspection door. It is designed to work at a pressure of 150 lb. per square inch, and is tested to double that pressure. Larger units, with a horizontal air receiver, are also exhibited. In Fig. 6

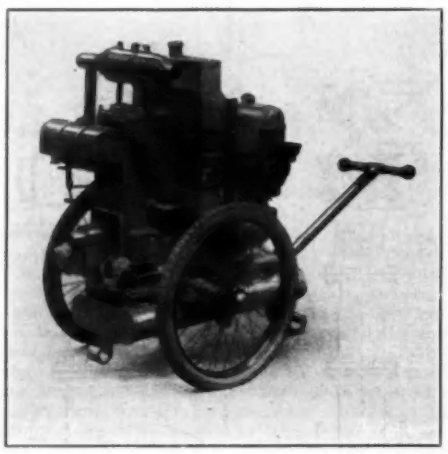


FIG. 9—PORTABLE SPRAYING OUTFIT—LACY-HULBERT

we show another of the firm's portable air compressing units. It consists of a four-cylinder four-stroke "Dorman" petrol engine, coupled direct to a compressor similar to the one above described, but of larger output. The compressor is designed to deliver 80 cubic feet of free air per minute, compressed to 100 lb. per square inch when running at about 1000 r.p.m. We may call attention to the simple flexible coupling between the engine and compressor, which takes the form of an annular flexible belt, bridging the two couplings. The engine is complete with its own circulating water and lubricating oil pumps, and a large radiator is provided. The compressor delivers direct to the air container, which is furnished with the usual gauge and safety valve fittings. Besides the governor controlling the speed of the engine, there is an automatic air-operated governor controlled by the compressor, which regulates the carburetter and enables the engine to turn round slowly at no load during the time the plant is unloading. The fuel tank carries a sufficient supply for about a day's service. As shown, the plant is carried on a simple chassis, with a swivelling fore-carriage mounted on broad-flanged cast steel wheels. When specially called for, springs, Ackerman steering gear and expanding wheel brakes can be fitted, or rubber and pneumatic tires provided.

The photograph reproduced in Fig. 7 shows a neat design of paraffin spraying gun, which is supplied by the firm for cleaning motor car engines, chassis and machinery, and for disinfecting buildings, &c. The sprayer has a good length, so that it can reach inaccessible parts of the object to be sprayed, and there are separate controls for the air and the paraffin. The air is controlled by a trigger and a small cock regulates the supply of paraffin. A feature of the design is the arrangement of the spray nozzle, which is such as to permit the air spray to be used alone when drying off sprayed surfaces or blowing out dust.

A neat form of portable spraying outfit, which is supplied either with a petrol engine drive as illustrated in Fig. 9 or with electric motor drive, is shown on the stand. As our illustration indicates, the unit is mounted on a tubular base, which serves as an air container and an oil separator, and the whole apparatus is carried on two light rubber tired wheels, making it very mobile. The engine is a Lister-Ricardo 2 B.H.P. unit, coupled to a high-speed compressor, with an output of 9 cubic feet of free air per minute, delivered at a working pressure of 80 lb. to 100 lb. per square inch. The designed engine speed is 1260 to 1400 r.p.m., at which there is a large margin of power available. A selection of pneumatic tools is also on view on the stand.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD.

A 7½-kilowatt 110-volt ship's lighting set, consisting of a single-cylinder enclosed engine directly coupled to a single-pedestal bearing generator, is one of the exhibits of the Metropolitan-Vickers

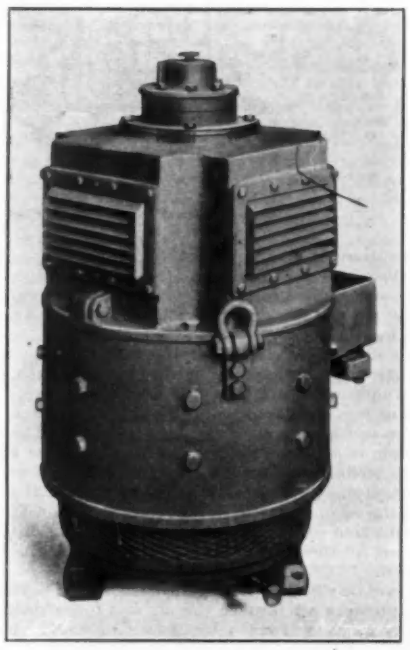


FIG. 10—VERTICAL PUMP MOTOR—METRO.-VICKERS

Electrical Company, of Trafford Park, Manchester. The normal working pressure of the engine is 120 lb. per square inch, but it is capable of operating on pressures up to 200 lb. per square inch. The speed is 550 revolutions per minute. Another of this firm's exhibits is the 5 horse-power vertical pump motor, shown in Fig. 10. By means of a shunt control rheostat it is possible to raise the normal speed—*i.e.*, 1200 revolutions per minute—to 1800 revolutions, with a temperature rise not exceeding 40 deg. Cent. The enclosure is said to enable the machine to work satisfactorily in a highly corrosive atmosphere. In the top bracket there is a location bearing, which takes the weight of the armature, and which is capable of absorbing a pump thrust up to 800 lb. A combined bracket and foot is provided for attachment to the pump setting. A standard 10 horse-power vertical marine type motor, designed for high-speed centrifugal pump drives, is shown. Series turns on the field magnets enable these motors to start up against considerable overloads. The normal speed of the particular motor exhibited is 1200 revolutions per minute, but it may be increased to 1600 revolutions per minute by means of shunt field control. Special precautions have been taken in the design of these motors to ensure quiet operation, even at the highest speed. A standard control panel for use in conjunction with a 7½-kilowatt generator is also to be seen on this firm's stand. It is composed of bevelled ebony sindanyo, mounted on a strong angle iron frame, which can be made suitable for deck or bulk-head mounting. Sindanyo offers the advantages of being stronger and lighter than slate. The readings of the instruments are said to be unaffected by the

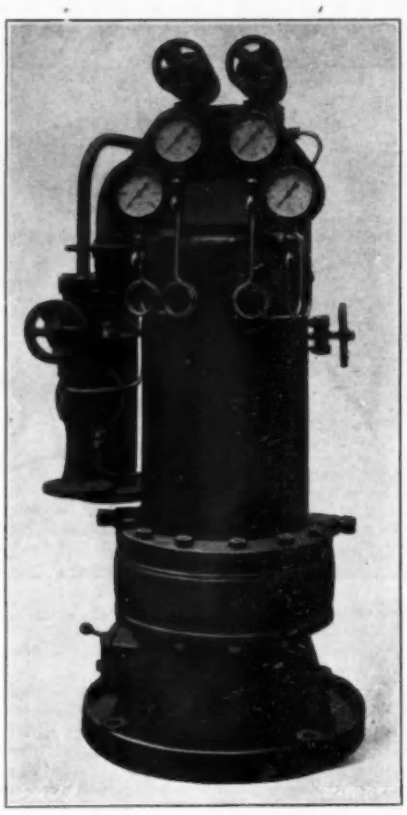


FIG. 11—TWO-STAGE AIR EJECTOR—METRO.-VICKERS

rolling and pitching of the ship. The two-stage steam operated air ejector, shown in Fig. 11, which is also exhibited, has a tubular inter-cooler and heater in one casing, the tubes being of the field pattern. The particular ejector shown is capable of maintaining a vacuum of 28½in. Hg in a condenser for a 4000 B.H.P. turbine, the steam consumption being approximately 275 lb. per hour. The vertical 3in. centrifugal condensate extraction pump, shown in

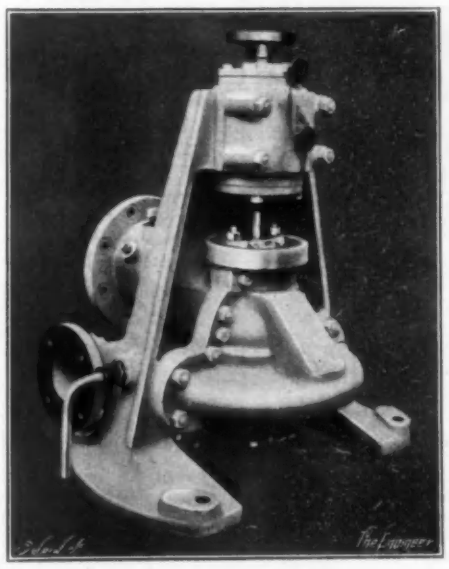


FIG. 12—CENTRIFUGAL EXTRACTION PUMP—METRO.-VICKERS

Fig. 12, is designed for a direct drive from the slow-speed shaft of the speed reduction gear of turbines up to 7000 B.H.P., the pump speed being 1500 revolutions per minute. The pump can also be driven by a vertical electric motor supported on a seating cast on the pump frame. The shaft gland is pressure-sealed, which makes leakage of air into the pump impossible. Other exhibits consist of a reduction wheel and pinion, a 1½ horse-power motor suitable for oil separator drives, an 11 horse-power totally enclosed ventilated motor, a 2½ horse-power silent motor, and a 50 horse-power ventilated motor which is opened up

so that the parts may be inspected. Cabin fans and marine wiring accessories, &c., are also on view.

THE OZALID COMPANY, LTD.

On the stand of the Ozalid Company, Ltd., of 1, Central Buildings, Westminster, there is a working exhibit of plant for the production of photo-prints by the company's true-to-scale process, the developing machine for which is illustrated in Figs. 13 and 14. This process involves the subjection of the print to the fumes of ammonia and the essential features of the machine are a closed box, through

FIG. 13—PHOTO-DEVELOPING MACHINE—OZALID

which the print is drawn by a rubber band, where the print is developed, and an airing chamber.

The developing chamber, it will be seen, is enclosed, with the exception of a narrow slot for the introduction of the print and another slot for its exit. The inlet slot is at the bottom of a door, which can be opened for ventilating purposes. Inside the box there is a rubber belt or blanket, which runs over a series of idler pulleys and underneath a felt-covered drum. The print is fed between this drum and the blanket and is fed forward. At the same time the blanket rubs over two small rollers, partly immersed in troughs containing liquid ammonia. In this way

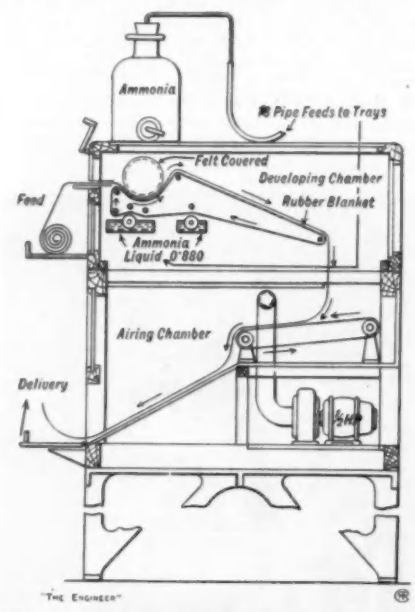


FIG. 14—SECTION OF PHOTO-DEVELOPING MACHINE

a thin film of ammonia is picked up, which effects the developing, while the box becomes filled with fumes. The developed print drops off the end of the blanket into the airing chamber below, where it falls on to a little band conveyor that feeds it forward to the delivery tray at the front of the machine. The airing chamber is ventilated by a small electrically driven fan, which discharges through a 2in. galvanised pipe. The drive for the developing blanket is effected through a pair of cone pulleys, so that its speed can be adjusted to the class of paper being used and to the depth of print required. The machine is capable of delivering prints flat, dry, and free from ammonia at the rate of 8ft. per minute, and occupies a space of 6ft. by 3ft. 6in. It requires about half a horse-power.

In their instructions for working the machine, the makers say:—After filling the two ammonia dishes, in which the rollers run, so that the sight-feed appears half full, switch the motor on. After the machine has run for a few minutes, the blanket and the developing chamber being sufficiently charged, start feeding prints. The print to be developed is placed, rolled up, on the platform in front of the feeding slot, and fed into the machine face downwards. It is not necessary to run the ventilating fan continually. When the machine is temporarily not working, it is recommended to keep the ventilator running for a short time, but do not forget to open the delivery flap. After the day's work, both slots are to be shut and both motors switched off. When the developing power decreases, *i.e.*, when the lines appear less dark, it is a sign that the ammonia in the machine needs renewing, by letting out, say, half a pint of the old liquid and replacing with fresh. For letting the old ammonia out, open the clips and empty the dark-coloured ammonia into a bottle. Before refilling, note that the tubes are closed up again by the pressure clips. For eight hours' working, the consumption of ammonia amounts to about 10 pints. It is important that the ammonia trays are thoroughly swabbed out and cleaned every three weeks, and that the rubber blanket and ammonia pick-up rollers are cleaned at the same time with a rag moistened with benzine.

On this stand there are also some samples of Ozalid half-tone paper for producing commercial photographic prints of technical subjects, without a dark room and without washing, together with various chemical preparations.

EDWARD BENNIS AND CO., LTD.

On the stand of Edward Bennis and Co., Ltd., of Little Hulton, Bolton, are to be seen several working models of the firm's stokers, working in conjunction with different types of boilers. They include a natural draught coking stoker fitted to a single-flue Davey Paxman "Economic" type boiler, a forced draught chain grate stoker of the new carrier bar type with multiple air control, a coal-pulverising plant, working on the "Simplex" unit" system, and a new type of air draught stoker applied to a three-flued marine boiler.

We have selected this latter exhibit for a more extensive description, and a drawing of this new type of furnace and grate is reproduced in Fig. 15. The furnace is a development of the firm's sprinkler type stoker and it embodies two new features. The first of these is a new system of air supply to the grate, which enables pre-heated air to be used, as well as air at normal temperature. When preheated air is used the second new feature makes provision for the introduction of cool air through the bars in order to prevent overheating of the metal of which they are formed.

It will be recalled that in the earlier type of Bennis high-pressure air furnace the air was forced into the hollow furnace troughs by means of small jets of steam. Although this system has worked with economy and efficiency for many years, it has been recognised by the firm for some time past that a system which would do away with the use of steam and would enable the necessary air for combustion to be supplied by means of a small fan would prove beneficial for many installations. Particularly would this be the case in marine installations where any loss of steam has to be compensated for by additional make-up water, with a consequent increase in the duty of the evaporating plant.

In the new furnace illustrated in the accompanying engraving, the self-cleaning action of the earlier type of furnace has been retained and the general form of the hollow furnace trough is unaltered, except in respect of its now being adapted for working with an air supply at a lower pressure and velocity than was previously employed with the steam jet system.

As the drawing indicates, a series of tubes fed from a common hot air duct project into the heads of the furnace troughs and supply the proportion of air needed for combustion. The fan supplying the air may be connected directly with the main duct in the case of a single boiler, or in a range of boilers the air supply main may be more conveniently carried beneath the boiler-room floor and connected to the various ducts by branch pipes. When using pre-heated air, it has been observed by the makers that the bars which form the grate surface are heated to a considerable temperature, and that the metal then shows signs of growth which reduces the life of the bars. In the new system this undesirable feature has been overcome by introducing currents of cool air, which flow through each of the bars from the front to the back of the grate. As the right-hand section shows, the cooling air is supplied through a small independent duct, which is arranged above the main duct and furnished with the requisite number of outlet nozzles, one for each of the hollow furnace bars. The working pressure employed is, we are informed, considerably higher than that employed for the heated combustion air. The supply of cooling air can in most cases be conveniently obtained from a by-pass connection on the discharge side of the pre-heater fan at a point on the cool side of the pre-heater unit. As the cooling air flows through the furnace bars it is raised in temperature, and at the rear end of the furnace it is directed by suitable passages into the main troughs below the furnace bed. It then rises obliquely upwards from the troughs, and finds its way into the furnace bed through a series of narrow graduated air spaces between the bars, which fill the tops of the troughs. The cool air, on the other hand, flows horizontally through the individual bars, close to, but isolated from, the fuel bed, thus maintaining a moderate temperature in the bars themselves. The new system may also be applied equally well to the Lancashire and other types of boilers.

GLENFIELD AND KENNEDY, LTD.

An exhibit of considerable interest on the stand of Glenfield and Kennedy, Ltd., Kilmarnock, is the drop-tight tilting disc reflux valve illustrated in Fig. 17. This valve is claimed to possess a novel

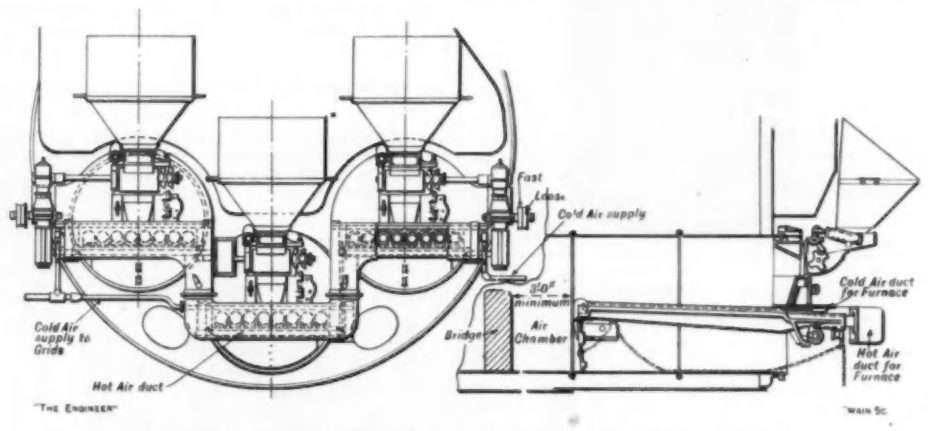


FIG. 15—SELF-CLEANING FURNACE WITH AIR COOLED BARS—BENNIS

feature, in that it rotates through its own seat. It is applicable for governing the flow in one direction of gases, vapours or liquids and is claimed to combine the tightness of a sluice valve with the freedom of rotation characteristic of a simple pivoted disc valve.

The valve consists of a rigid dish-shaped door

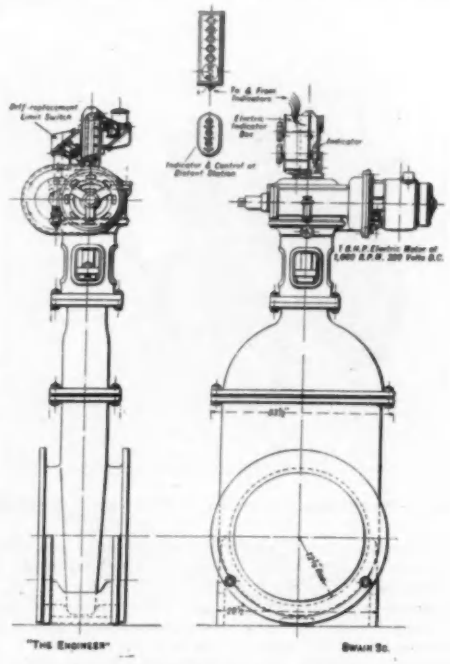


FIG. 16—SLUICE VALVE—GLENFIELD

pivoted within a cylindrical casing. The casing is divided on an inclined plane as shown in the external view, and at the junction is provided with a bevelled, truly circular valve seat. The door is pivoted eccentrically in accordance with the principle indicated in Fig. 18, which represents a vertical section through

the centre line of the valve. A B C D represents the seat on the door in the closed position and X O Y the angle of the seat bevel. A E and C F are normals drawn to X O and Y O from the points A and C respectively and intersect at a point G. To open the valve the door is rotated clockwise from the position shown in the diagram. It is evident, as regards the point A on the door seat, that if the pivoting point is situated anywhere to the *left* of the line A E, the point A, when the door is rotated, will move clear of the body without sliding action. So, too, will every other point on the door seat between A and B. It, therefore, follows that when the door is rotated to

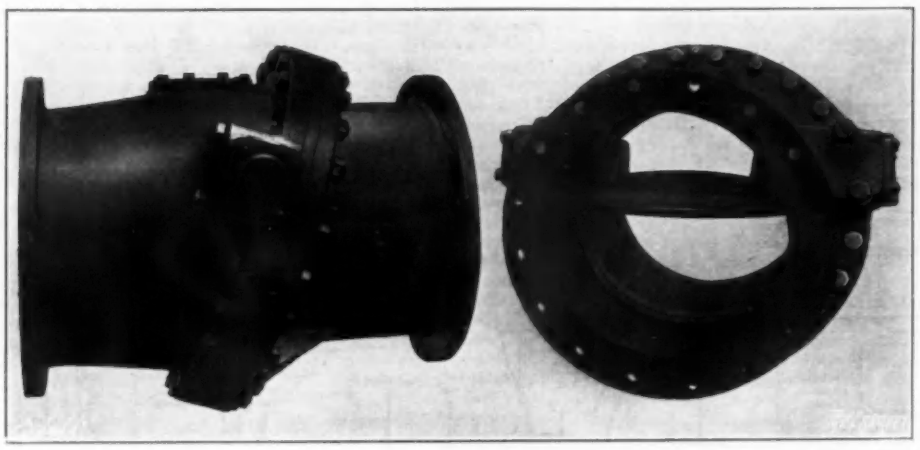


FIG. 17—TILTING DISC REFLUX VALVE—GLENFIELD

open the valve the upper portion of the door rotates through its own seat. If the pivot were placed exactly at G, the angle of recession of the door seat from the body seat would be exactly 90 deg. and sliding would occur. If the pivot were situated to the *right* of the line A E, the angle of recession would exceed 90 deg. and it would be impossible to open the valve. As regards the lower portion of the door, it is evident that if the pivot is situated anywhere to the *right* of the line C F, the point C and *a fortiori* all other points between C and D will move clear of the body seat when the door is rotated. To fulfil both requirements the pivot must be placed somewhere within the angle A G F as indicated in the diagram.

In the ordinary flap type of reflux valve the hydraulic losses are relatively high by virtue of the

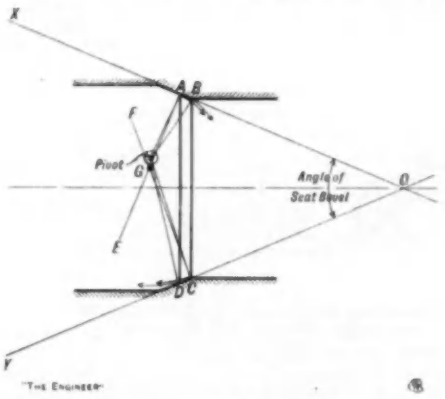


FIG. 18—PRINCIPLE OF REFLUX VALVE

fact that the door has to be lifted and maintained off its seat entirely by the flowing fluid. The tilting disc valve, it is claimed, is, on the other hand, very easy to open, and as the greater part of the weight is borne by the pivots and not by the fluid stream a very small force is required to maintain the valve in the open condition. This small hydraulic loss, the makers point out, represents an appreciable saving of power when large quantities of water have to be pumped, as in circulating systems, irrigation and drainage. The closing of the valve illustrated is produced by a combination of the unbalanced weight and the action of the stream of fluid on the longer flap of the valve. The shorter flap is forced backwards against the stream and helps to cushion the closing motion and to prevent slamming.

We are informed that numerous valves of this pattern have recently been supplied to power stations, waterworks, and pump manufacturers in this country and abroad in sizes ranging from 4in. to 45in. diameter.

Another exhibit on Glenfield and Kennedy's stand is an electrically operated sluice valve with distant indicating and control equipment. This valve is illustrated in Fig. 16, and in general conforms with the makers' usual practice, in that it has a cast iron body, door and dome, four gun-metal faces, and a forged bronze operating screw working in conjunction with a gun-metal nut. On top of the valve dome there is bolted a cast iron stool provided with hand holes for facilitating the re-packing of the gland and supporting the valve-operating gear. This gear consists of a phosphor-bronze worm wheel and a mild steel worm driven through reduction spur wheels by a 1 B.H.P. electric motor. Attention is called to the manner in which the motor is mounted. The usual extension bracket is dispensed with and instead the motor stator is provided with a flanged cylindrical extension which is bolted directly to the spur gear casing. The worm and spur gearing run in totally enclosed oil baths and each end of the worm shaft is fitted with ball washers. In the event of the current failing the valve can be operated by means of a crank handle.

The valve is controlled by a system of push buttons and contactor gear. A set of push buttons is provided near the valve itself and another at any remote situation for the purposes of distant control. Indicator gear is provided which shows at the remote station the position of the valve at any instant. Alternative indicating systems are available. In one the indications are given by a series of lamps which are illuminated according to whether the valve is open, shut, or in any one of a number of intermediate positions. An indicator box is mounted on top of the gear casing on the valve. The lamps are connected to a corresponding series of contact studs in this box, and as the valve is operated a spring contact arm passes over these studs and causes the lamps to light up in turn. The second method of indicating the degree of opening of the valve consists of the use of a Midworth distant repeater comprising a transmitting instrument geared to the valve operating spindle and a receiving instrument situated at the remote station. The system is electrically operated and is so designed that its accuracy is not affected by any change which may occur in the voltage or resistance of the circuit. Further, it is such that the receiving and transmitting instruments cannot get out of step even should the connecting circuit be broken and restored after an interval of time.

Water meters, oil sluice valves, hygienic drinking fountains and non-concussive self-closing water taps are included among the other exhibits on the company's stand.

ELECTROFLO METERS COMPANY, LTD.

The exhibits of Electroflo Meters Company, Ltd., of Abbey-road, Park Royal, illustrate the company's recent designs of industrial instruments. By means of the company's multiple metering systems the records that are necessary to secure efficient operating of power plants can be made on a 12in. chart. Any number of records up to a maximum of six can be made electrically without any restriction on the position of the recording panel. As the charts are electrically driven there is no clock to wind.

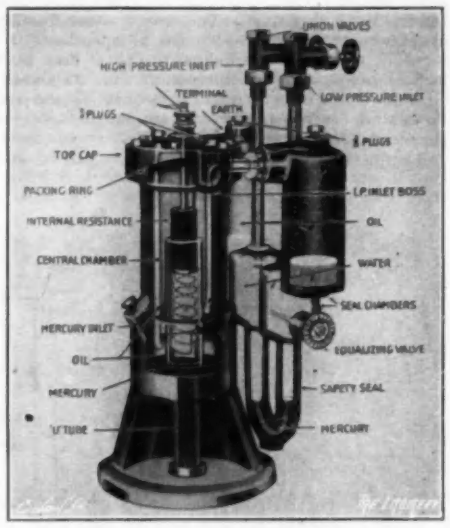


FIG. 20—METER BODY—ELECTROFLO

The charts serve for 1200 hours, and by means of an extension slide the records for a period of twenty-four hours are exposed. Only when the intermingling of

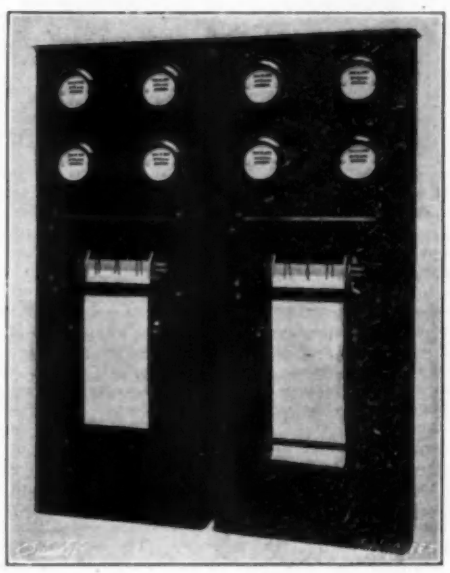


FIG. 21—STEAM FLOW RECORDER—ELECTROFLO

records is essential does any intermingling occur. With these recorders a superintending engineer can readily compare related records, and obtain an immediate indication of operating efficiency. Obviously it is much more convenient to compare the records on a single chart than it is to compare those on a number of charts. The recorders are mounted on pressed steel self-supporting panels finished in black cellulose

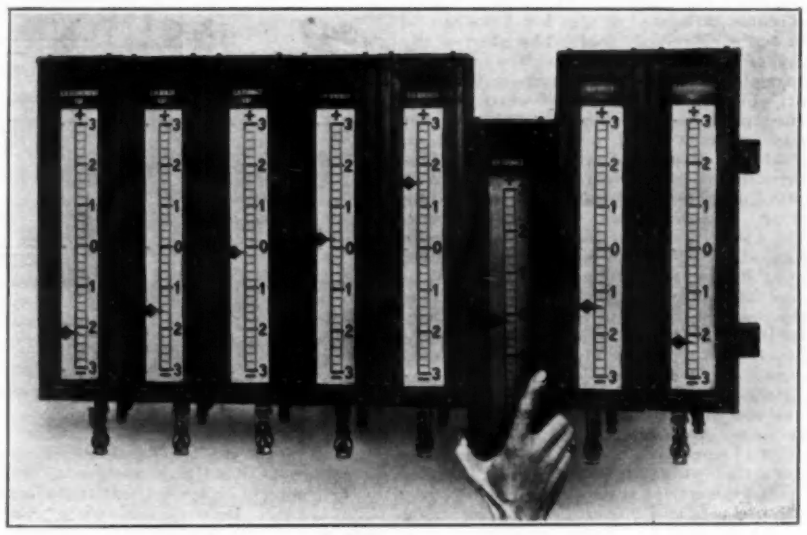


FIG. 19—MULTIPLE DRAUGHT INDICATOR—ELECTROFLO

enamel and the panels also carry the required number of integrators, thermo-electric or electrical resistance pyrometers, pressure and temperature gauges, &c.

The indicators, recorders and integrators of the flow meters read directly in thousands of gallons, cubic feet or pounds per hour, all multiplying factors having been abolished. The firm's latest five-figure cyclometer type indicators are independent of the recorder movement and show the total flow by five large numerals. The illustration Fig. 21 shows an equipment for integrating and recording eight steam-flows and for recording two temperatures and two pressures.

The method of measuring fluid flow will be understood from Fig. 20, which shows the meter body. It will be seen that there are two short pipes, terminating in valves above the meter body. These two pipes are connected by means of ¾in. piping to tappings in the main on either side of the flanges between which the orifice plate is placed, the upstream pressure being admitted to the left-hand connection and the downstream to the other. The upstream connection leads to the annular chamber containing mercury, and the downstream connection to the central chamber, in which a resistance element is inserted. When there is a flow in the pipe the pressure downstream becomes lower than that upstream, the mercury level being depressed in the annular chamber and raised in the central chamber in proportion to the impact of the flow. The rise and fall of the mercury in the central chamber regulates the flow of current through the electric circuit by varying the circuit resistance through the medium of the resistance element, which is suspended over the mercury. The resistance is so arranged that the flow of current in the circuit is directly proportional to the flow of fluid in the pipe. The resistance element is literally the base of the patents protecting the Electroflo metering system, although the system of making the meter independent of external voltage regulation is also protected by British and foreign patents.

The resultant electric current flow follows a straight-line law and the electrical indicators and recorders are consequently arranged with wide, evenly graduated scales, calibrated so that low flows can be accurately and conveniently read. The effect of the rise and fall of the mercury is to vary the resistance in the electrical circuit and not to "make and break" the circuit, which is only interrupted when the flow through the pipe ceases. The meter body is provided with a mercury safety seal, automatic in action, which operates in a manner similar to that of a fuse in an electric circuit. It prevents the blowing out of the mercury, and the resulting tedious work of refilling and resetting. The seal ensures continuity of operation. When a sudden surge of impact pressure occurs the mercury in the U-tube is blown into the water compartment shown in Fig. 20, where it continues to bubble until the abnormal pressure is released. This action equalises the pressure in the two oil compartments, also shown in Fig. 20, and causes the mercury in the U-tube of the meter body to return to zero level. As soon as the surge ceases the mercury again collects in the U-tube and re-establishes the seal between the two compartments. No mercury is lost during the surge. Normally a 12in. diameter chart type recorder is employed, but the records can also be made on a 12in. wide strip chart recorder forming part of a multiple metering system. For the measurement of temperature and pressure a temperature or pressure helix is used to operate a contact arm moving over a continuous resistance which is part of an electric circuit in which the recording movement is included. The variation in resistance causes a corresponding movement in the recording pen and results in a sensitive record of temperature or pressure fluctuation. The measurement of temperature is accomplished by inserting a temperature bulb in the hot zone. The bulb contains an expansive medium—usually nitrogen—and is connected to the temperature helix by an armoured copper capillary tube. The movement of the helix, as the result of temperature fluctuations, causes a corresponding travel of the contact arm across the continuous resistance. In the case of the measurement of pressure the bulb is, of course, eliminated and the pressure is applied direct to the helix. Its response to pressure fluctuations causes the contact arm to move across the resistance and so to vary the resistance in the electric circuit, thus in turn causing a corresponding movement of the recording pen on the continuous strip chart.

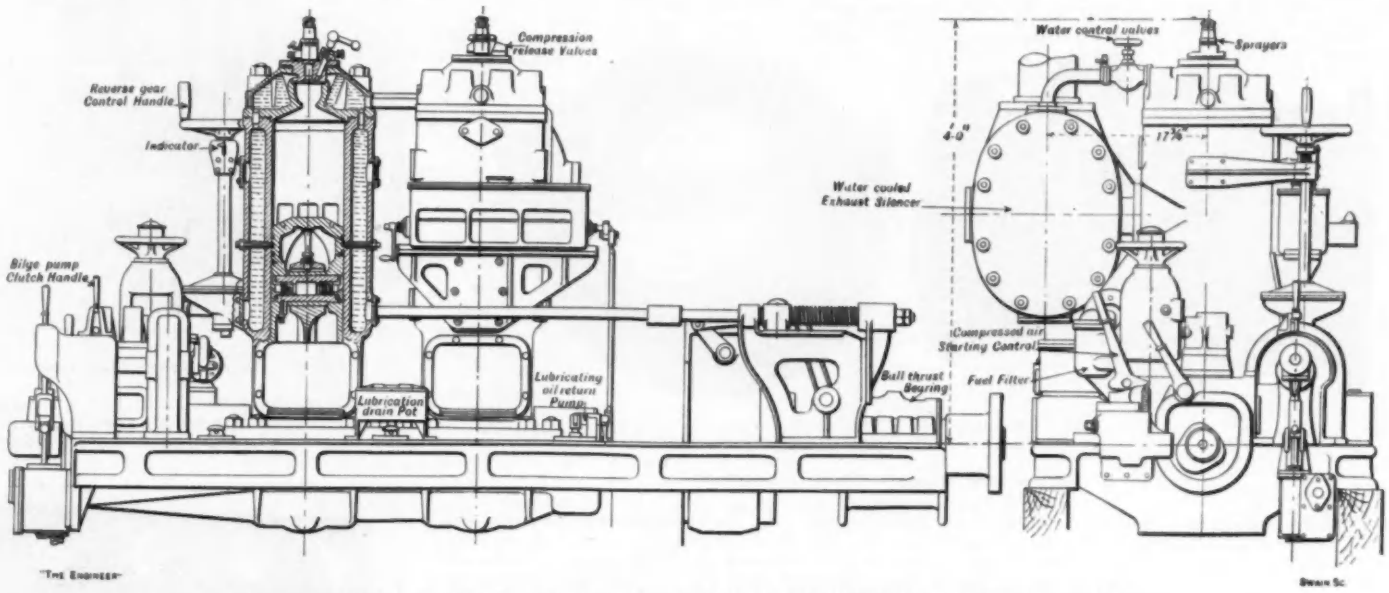


FIG. 22—50 B.H.P. COLD STARTING TWO-STROKE SINGLE-ACTING "ATOMIC" MARINE ENGINE—PETTERS

-CO_2 analysis is accomplished with the Electroflo motor-driven analyser. An oil submerged motor-driven pump draws a continuous supply of flue gas to the instrument. A sample of definite volume is periodically sealed off in a primary measuring chamber and it is then forced through a caustic potash tank, in which precautions are taken to ensure the complete absorption of CO_2. It then enters a secondary measuring chamber, which rises to a height which is proportional to the volume of residual gas. The rise of this secondary measuring chamber causes the recorder pen and the indicating pointer to take up positions on the chart and scale corresponding to the percentage of CO_2 in the gas analysed. The time taken for the complete cycle of operations is approximately 1 min. 40 sec. Between analyses a brake holds the recorder pen and pointer in the position taken up, thus permitting a continuous record to be obtained on the chart without a fall to zero after the completion of each analysis. When the instrument is used as a part of the multiple metering system the motor-driven analyser is fitted with a transmitter, and when the secondary measuring chamber rises, instead of causing a pen to move across a chart, and a pointer across a scale, it causes a contact arm to move across a continuous resistance which is part of an electric circuit in which the recorder movement of the multiple metering system is included. The variation of resistance causes a corresponding movement of the recorder pen with a resulting record of CO_2 content on the continuous strip chart. The effect of friction between the contact arm and resistance is avoided by causing the contact arm to be depressed at intervals corresponding to each analysis.

The Electroflo multiple draught indicator shown in Fig. 19, which is also exhibited, offers the advantage that each movement is self-contained and may be removed for test or recalibration purposes without interfering with any other movement of the complete indicator. Obviously, the instrument enables engineers to compare related draughts and pressures.

PETTERS LTD.

Prominent exhibits to be seen on the stand of Petters Ltd., of Westland Works, Yeovil, are three surface ignition cold-starting marine oil engines of 8 B.H.P., 18 B.H.P., and 36 B.H.P. output, com-

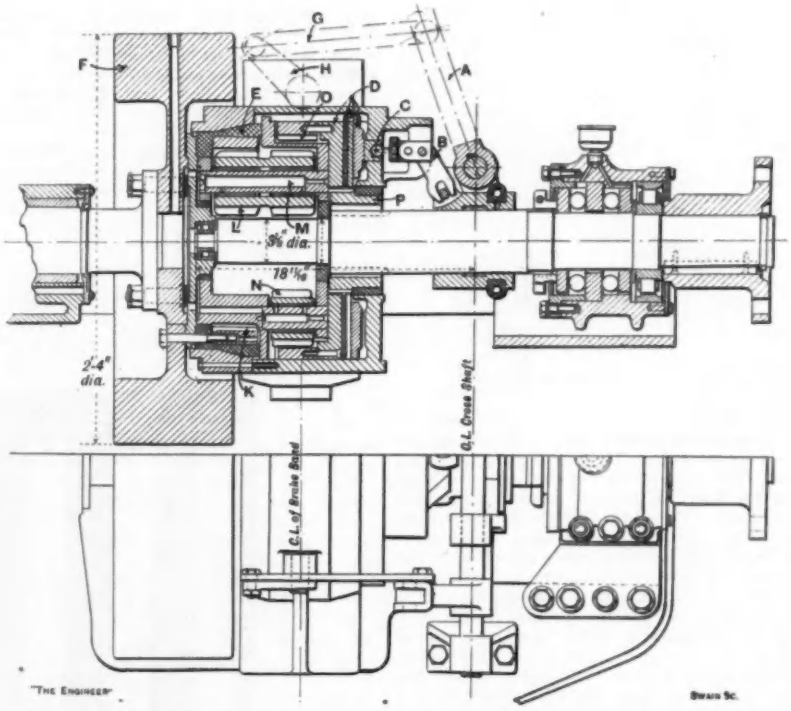


FIG. 23—REVERSING GEAR AND CLUTCH—PETTERS

plete with reversing gears, which are representative of the firm's range of such engines built in sizes from 5 B.H.P. up to 36 B.H.P.

We have chosen for special description a larger marine oil engine of 50 B.H.P. with twin cylinders, which represents the extension of the "Atomic" Diesel design, described in our B.I.F. Supplement of February 15th last, to marine engines, which may now be built in powers up to 260 B.H.P. It will be recalled that the "Atomic" Diesel is an airless, springless injection, cold-starting engine working on the two-stroke single-acting principle, with the comparatively

high compression pressure of 450 lb. to 550 lb. per square inch and with crank case compression. As shown in Fig. 22, the lower half of the crank case is formed in the bed-plate casting, the upper half consisting of a separate casting which is part of the cylinder liner and casing. The crank case is small in capacity with a view to giving a high volumetric efficiency, with thorough scavenging. A one-piece casting forms the liner and cylinder casing, and, after boring, the surface of the liner is finished in a "honing" machine, which is constructed to give a completely cylindrical bore with a high surface finish, a valuable feature in engines with ports. The cylinder heads are symmetrical in shape and they are machined internally, in order to give an equal sized combustion space for each cylinder.

The drawing shows the steel H-section connecting-rod with its top end bearing and piston pin. The upper end of the piston, it may be noted, is slightly conical in shape, and in addition to four piston rings it carries a single oil scraping ring at the lower end of the skirt. The cylinder shown in section indicates some of the main parts and also the central cylinder head block which carries the spray valve and a compressor relief valve. The latter valve takes the form of a plug with a milled thread made in the style of a breech block, which, when turned, instantly relieves the pressure within the cylinder. To the left of Fig. 22 and also in the right-hand end view will be seen the group of fuel pumps, starting air compressor, governor and clutch controls. The starting air is distributed by a special valve operated from a cam on the end of the crank shaft, which admits air to the cylinders at the correct starting point at a pressure of about 350 lb. per square inch. Air receivers are employed to store surplus starting air.

The fuel pump and governor gear is generally

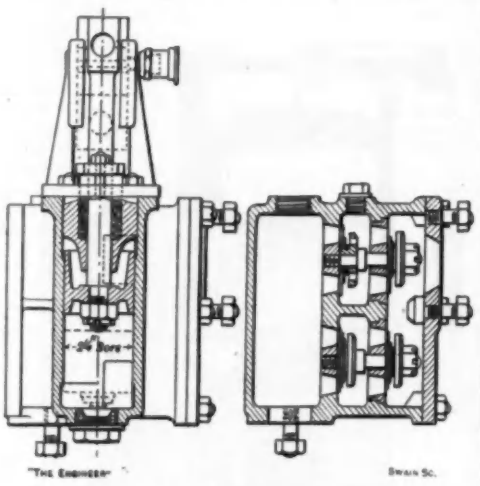


FIG. 24—CIRCULATING PUMP—PETTERS

similar to that described and illustrated in our Supplement of February 15th, one pump of a glandless type being provided for each working cylinder. Forced lubrication is fitted on all main bearings and to the cylinder liners and is furnished by a "Calibrator" mechanically operated lubricator. The crank pins are fed from a centrifugal oiling device, and provision is made to blow out any surplus oil which may collect in the crank case into a collecting receptacle. This is done by crank case compression, a special valve being fitted for the purpose. The engine we illustrate has a designed speed of about 400 r.p.m. Its rated fuel consumption is 0·48 lb. of oil per B.H.P. hour, which is equivalent to a thermal efficiency of 28 per cent. when using a fuel oil having a calorific value of 19,000 B.Th.U. per pound.

In a marine engine special provision has to be made for fitting circulating pumps and bilge pumps. In Fig. 24 we show a section through the circulating pump. This is spur gear driven from the crank shaft through a lay shaft running at 300 r.p.m. The pump is operated from a small crank on this shaft and the pump connecting-rod large end is fitted with a ball bearing with a guided piston-rod crosshead. The pump operates on the double-acting principle and it is furnished with plate valves of the "Kinghorn" type. Accessibility has been carefully considered, and all parts are made in gun-metal in order to resist corrosion. The pump has a designed output of 1000 gallons per hour. At the forward end of the engine there is a bilge pump of the same type as the circulating pump just described, which is controlled by a friction clutch and is driven from a second crank on the lay shaft. In normal service both of these pumps make about 300 strokes per minute.

The reverse and clutch gear shown in section in Fig. 23 is of particular interest, since it has been specially designed for use with heavy-duty engines. As will be seen from the longitudinal view of the engine reproduced in Fig. 22, the reverse gear is mounted on an extension of the main bed-plate, which also carries the ball thrust bearing. At its after end the reverse gear shaft is supported by a roller bearing carried in a housing, which is bolted to the bed-plate casting. The reverse gear is of the epicyclic type, the forward drive being transmitted by means of a clutch which locks the gears. The reverse drive is obtained, not by locked gear teeth, but by one internal gear wheel which transmits motion through four pairs of pinions to a second gear wheel, there being no gear wheel on the central shaft. As each pinion has three points of contact, it is claimed that the arrangement is one which permits low teeth stresses and reduces bearing wear.

The operation of the clutch and reverse gear is carried out in the following manner. Movement of the control hand wheel shown to the left of Fig. 22 operates through gearing a nut controlling the cross shaft. When the reversing lever A—Fig. 23—is moved in a forward direction, it slides the sleeve along the shaft, and actuates the toggle mechanism B. It may be noted that the end of the toggle gear is joined to the clutch disc by a ball joint C. The operation of the toggle gear compresses the clutch discs D, and also the clutch member E, and locks the various parts of the gear to the fly-wheel F. When, on the other hand, the reversing lever A is moved in the after direction, the toggle mechanism is withdrawn and the clutch members are released, allowing the gear to run in the neutral position. Further movement of the lever A, however, operates the levers G and H, thereby contracting the brake band. When this is done the outside of the gear casing is brought to rest, and held stationary, and the engine drive is transmitted through the internal gear wheel K, which is bolted to the fly-wheel. In mesh with the wheel K there are four double pinions L, carried on pins M, which are spaced around the shaft at 90 deg. intervals. As shown by the drawing, Fig. 23, these pinions mesh at their astern ends with four other pinions N, which, in turn, gear with the internal ring O. This gear ring is attached to the foremost member of the clutch D, which slides on splines on the member P, which is keyed to the reverse gear shaft. When the brake band is contracted, the internal gear wheel K rotates the pinions L, which drive the pinions N and the internal gear O, which is connected to the tail shaft. A speed ratio of 85 per cent. reverse to forward is provided. The whole of the gear is very compact, and forms, with the engine unit, a very neat arrangement.

Other exhibits on Messrs. Petters' stand include a series of small oil engine sets for compressed air and auxiliary lighting, having outputs from 1½ up to 12 B.H.P.

BABCOCK AND WILCOX, LTD.

The stand of Babcock and Wilcox, Ltd., of London and Renfrew, is devoted to a varied display of a number of full-sized details of the firm's patented water-tube boilers and modern firing equipment. The oil-firing equipment of the pressure type designed for use both on land and at sea, is illustrated by a furnace section complete with a Babcock pressure type oil burner. A noteworthy exhibit is the combined oil pumping and heating plant illustrated in Fig. 26. It is of the "Duplex" pattern, which design comprises a complete standby unit, in addition to the unit in actual operation. The pumps are of the vertical "Simplex" double-acting pattern, and they are furnished with large air vessels having a spring loaded relief valve with a wide range of adjustment. The particular plant shown on the stand, and illustrated herewith, has a designed output of 1500 lb. of oil fuel per hour.

Some noteworthy features of design include the provision of filters between the pump discharge and the oil heaters, as well as on the discharge side of the heaters. Strainers are also fitted on the suction side of the oil fuel pipe line. Provision is made to work the pumps by means of hand levers when steam is not available, and in such a case the oil is by-passed directly to the suction side of the filters, arrangements being made to heat the oil elsewhere during the period of hand operation. In the larger sizes of plant a separate pressure hand pump is fitted which obviates the use of the special by-pass gear just referred to.

Other forms of equipment for oil-firing installations include examples of standard air registers fitted with oil pressure burners and steam atomisers. Another noteworthy exhibit consists of the Babcock feed-water regulator—shown in section in Fig. 25. The regulator consists of a hollow cylinder, which is rotated on its axis by means of a float and lever

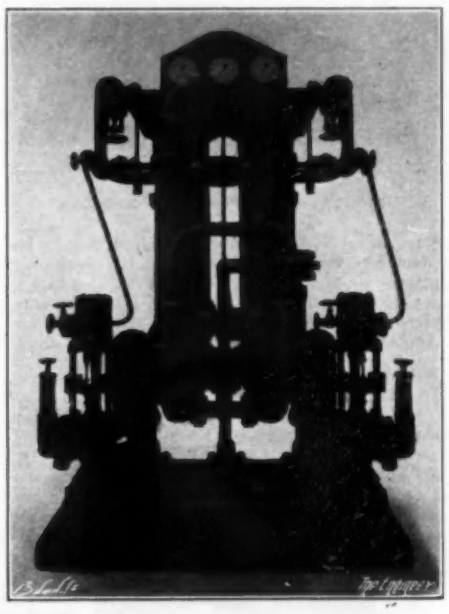


FIG. 26—OIL PUMP AND HEATER—BABCOCK

accommodated inside the boiler drum. The cylinder has ports cut diagonally along its walls, and works in a liner having corresponding ports. The liner is housed in a casting or box attached to the boiler shell, and this casting carries one branch for a feed-check valve, and another branch for a pipe leading to a non-return feed valve on the boiler drum.

The cylinder is moved lengthways along the liner by means of a suitable adjusting screw and spindle with a hand wheel, while the spindle is connected to the cylinder by ball bearings, so that friction is reduced to a minimum.

Attached to the spindle between the adjusting wheel and the gland, is a lever and rod, the latter extending to a position in the stokehold, where it can be easily worked by hand from the firing level. The object of this rod and lever is to enable the boiler attendant to ascertain whether the float is moving freely, when getting up steam, or to keep the float in the open or shut position should circumstances at any time so demand.

It will be seen that the position of the cylindrical valve is entirely regulated by the float in the boiler.

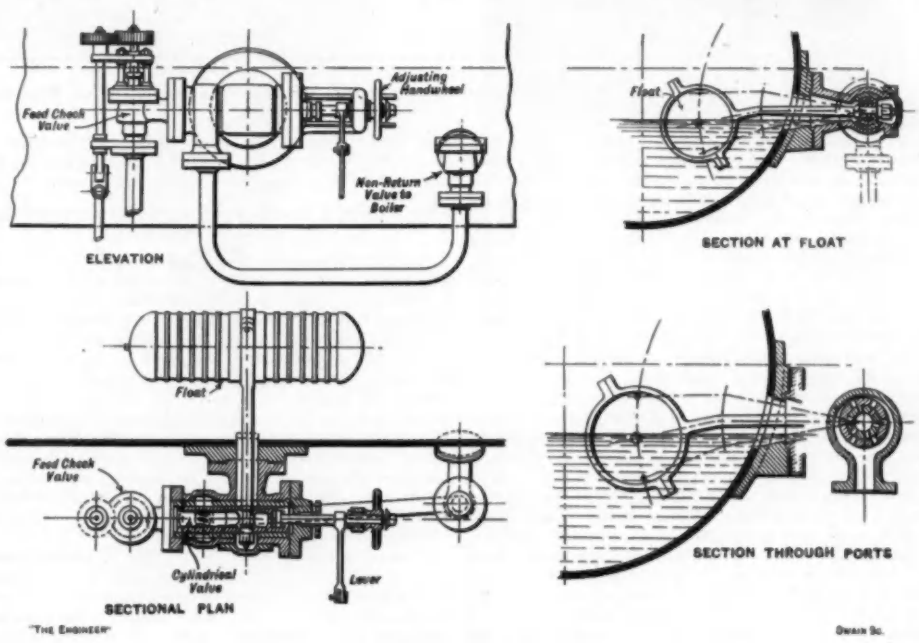


FIG. 25—FEED WATER REGULATOR—BABCOCK AND WILCOX

When the level of the water in the boiler is low, the ports will be open, and as the water rises in the boiler and carries the float with it, the cylindrical valve will be moved round, and the ports gradually closed. In practice there should never be a difference of more than 1in. to 1½in. in the water level during the time

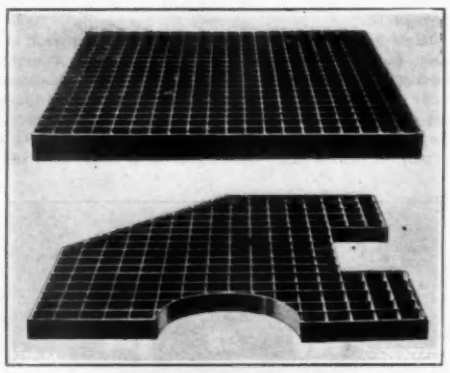


FIG. 27—STEEL FLOORING—BABCOCK

the regulator is in action, and there should be no appreciable variation in the sensitiveness of the regulator when the boilers are worked at a high or a low rate of evaporation or even when the rate is changed suddenly.

Another exhibit consists of a drum-end designed for a working pressure of 800 lb. per square inch, and further sectioned examples of water-tube boiler construction which include a marine header, showing in detail the hand-hole construction and the method of tube expansion. Some examples are also shown of the firm's high-pressure pipework, one section being a duplicate of that supplied to the Bradford Corporation for its 1100 lb. pressure Babcock plant, this being the highest pressure so far adopted for any plant in this country. Examples of welded flanges and similar details are also shown, and there is a varied selection of wrought steel Victory valves.

Fig. 27 shows two examples of the Babcock patented "Interlock" open steel flooring, which is largely used for the galleries and platforms of marine engine and boiler-rooms. By its particular construction, the Babcock flooring, it is stated, combines a maximum strength with a minimum weight. It is further claimed that no single member of the flooring can fail by overturning, twisting or buckling. Some loading tests recently carried out on a 4ft. by 2ft. section of floor showed that with a concentrated load of 1 ton over a span of 2ft. the total deflection was only ·021in., while with a concentrated load of 14 cwt. over a span of 4ft., the total deflection did not exceed ·56in. The lower view of Fig. 27 indicates how the flooring can be adapted for special shapes.

WILD, BARFIELD ELECTRIC FURNACES, LTD.

This firm has made arrangements with Matchless Motor Cycles, Ltd., and De Lavaud Free Wheel Differential, Ltd., to send men from their works and to divert their products that need to be heat-treated to the exhibition, where they are being dealt with in Wild, Barfield electro-magnetic furnaces, similar to those in the works of those two firms. It is believed that this arrangement is resulting in the largest exhibition of heat treatment that has ever been given, and that it is proving of great interest to the engineering trade generally. The furnaces that are employed are standard furnaces as used in works, but it will be noted from Fig. 28 that the control panels are self-contained units which are mounted on the floor, the controls, with the exception of the magnetic indicator, being behind the panels. The whole equipment, comprising the furnaces and the control gear, can be erected and set into operation by an ordinary works electrician. One of the vertical furnaces—shown in Fig. 28—has a 47-hour weekly output of 2½ tons of steel parts, and the other 1¾ tons; whilst the horizontal furnace—shown in Fig. 29—is capable of dealing with 3½ tons per 47-hour week. Those who are associated with carburising, annealing, &c., in large furnaces will be interested in the firm's automatically controlled furnace, which is to be seen in operation. Besides being used for carburising, annealing, &c., this furnace is also employed for the heat treatment of non-ferrous metals. The consumption of the furnace is 20 kilowatts. The heaters consist of specially prepared nickel chromium elements enclosed in bricks which constitute the chamber. A self-operating door switch ensures safety to the operator.

A new electrically heated die casting machine is also on view. The actual heating chamber is 8in. in diameter and 11½in. deep, and accommodates the pump mechanism, which consists of a cast iron pump and container. The maximum current consumption is 2 kilowatts. A hand controlled rheostat or an automatic regulator may be provided. Electrically heated high-speed steel-hardening furnaces are to be seen in operation. There are also automatically controlled oil and air tempering ovens.

THE MARCONI INTERNATIONAL MARINE COMMUNICATION COMPANY.

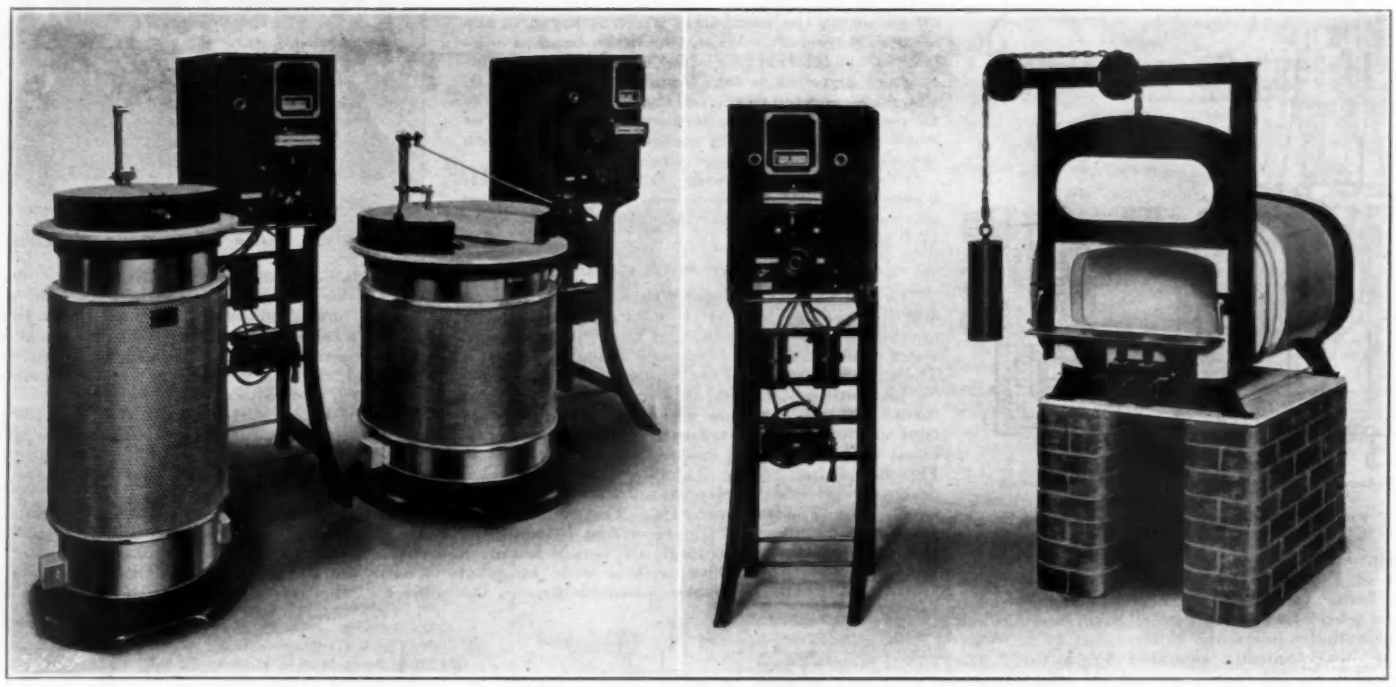
A comprehensive range of wireless and other apparatus is to be seen on the stand of the Marconi International Marine Communication Company, of Marconi House, Strand. Replicas of wireless cabins on large and small ships have been erected on the stand, and apparatus is arranged so that the space necessary for its installation on board ship may readily be estimated. In the largest cabin that has been erected a 2-kW valve transmitter for continuous and interrupted continuous wave telegraphy, a short-wave transmitter, a quenched spark emergency transmitter, and long and short-wave receivers are to be seen. The latest model Marconi direction finder, in which screened grid high-frequency amplifier valves are used, is also exhibited.

A smaller cabin contains a ¼-kW quenched spark transmitter, a two-valve receiver, and Marconi direction indicator, all accommodated in accordance with the method adopted on small ships. The direction indicator is a modified form of direction-finding receiver, comprising a small untuned single rotating frame used in conjunction with an amplifier. The instrument is designed to work over two wave length bands, 180 m. to 300 m. and 450 m. to 1100 m. Various other transmitters are exhibited, including new types of interrupted continuous wave valve transmitters of ¼ kW and 1½ kW capacity. A self-contained wireless telephone set intended for use on board yachts, whalers, trawlers and other small vessels where a skilled operator is not available, is shown.

It is well known that it is possible to communicate with short-wave installations over extreme ranges, and that under favourable conditions communication may be said to be world-wide. For this purpose, the Marconi Company has produced a short-wave telegraph and telephone transmitter, which has been specially designed for use on board ships. Tests with this new type of installation have proved remarkably satisfactory, distances of over 6000 miles having been recorded. The operation of the Marconi auto-alarm, which has been approved by the British Government for use on board ships which do not maintain a continuous wireless operator watch, is being demonstrated. More than 1000 sets of this apparatus have now been installed on British ships. Part of the stand is devoted to Marconi marine electrical equipment, including the Marconi depth-sounding devices.

SIEMENS BROTHERS AND CO., LTD.

Electrical distance thermometers, suitable for temperatures ranging from 200 deg. to 500 deg. Cent., are shown by Siemens Brothers and Co., Ltd., of Woolwich, who also exhibit pyrometers for temperatures ranging from 300 deg. to 1400 deg. Cent., and optical pyrometers for temperatures from 700 deg. to 2500 deg. Cent. A multi-way weatherproof switchboard permits a number of thermometers to be connected to a single indicator at will. Various types of thermometers are shown, including a ceiling thermometer, as illustrated in Fig. 30. A dry battery, which lasts many months, provides the necessary current. The thermometers are used extensively on land and sea, and are particularly suitable for measuring cold storage temperatures. If it is desired to obtain a permanent temperature record on a chart, a drum type recorder may be employed, as shown in Fig. 31. This instrument gives 24-hour records, after which period the chart must be changed. A continuous chart recorder is, however, supplied which



FIGS. 28 AND 29—VERTICAL AND HORIZONTAL ELECTRO-MAGNETIC HEAT TREATMENT FURNACES—WILD, BARFIELD

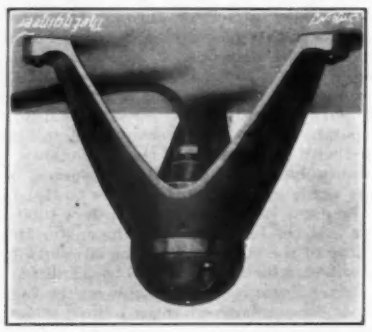


FIG. 30—CEILING THERMOMETER—SIEMENS

only requires a chart renewal every two months. This recorder is, moreover, provided with a seven-day clock. Various sizes of multi-way switchboards similar to that illustrated in Fig. 32, are supplied. Electrical connection between the pyrometer stems and the switchboard is made by a special compensating cable, which, we are told, is little more

expensive than the ordinary type of cable employed with distance thermometers. When the temperature at a single point is required, such as at a furnace, the switchboard is not, of course, needed, and several types of instruments for single indications and for wall or table mounting are available. Pyrometers of the type shown in Fig. 33 are used to a large extent on board ship for taking Diesel engine exhaust temperatures, the funnel uptake temperatures, &c., and for taking many temperatures in steel and other works on land.

Among the firm's marine exhibits is an electric telegraph apparatus for ships—see Fig. 34—which takes the place of the usual mechanically operated gear for communicating from the bridge to the engine-room, and for docking and steering. It is operated

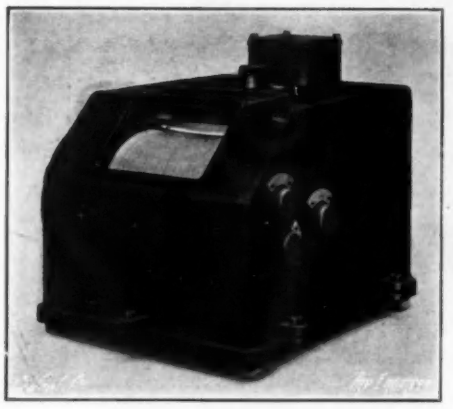


FIG. 31—TEMPERATURE RECORDER—SIEMENS

by means of primary batteries and is directly connected without the use of switches, so that the circuits cannot be accidentally left open. The system is not affected by the distance between the instruments, and can be operated on the largest vessels as easily as on the smallest craft. All the requirements of ships' telegraphs are fulfilled, for single or twin engines, dockings, &c.

The Siemens "Rotary" type ahead and astern revolution indicator—Fig. 35—has been designed primarily to indicate when the engines start and stop, but it also enables the revolutions per minute of the shaft to be ascertained. The short pointer moves one-tenth of a revolution of the dial for each revolution of the propeller shaft, and gives a very distinct indication of the movement of the engines, whilst the long thin pointer moves one division of the scale

FIG. 32—MULTI-WAY SWITCHBOARD—SIEMENS

for each revolution, so that the revolutions for any given period of time can be ascertained. No actual counting is required, but only a measurement of time. The apparatus is actuated from the ship's mains, and when it is not required the current can be switched off.

The navigation lights indicator shown in Fig. 36 gives luminous indications when the navigation lights are burning correctly, and an aural warning should any one of the lights be extinguished. The indicating lamps are not in series with the navigation light, so that a failure of the indicating lamp does not affect the burning of the navigation light.

Among the company's wireless exhibits are two I.C.W. transmitting units, designed to take the place of the ½ and 1½-kW spark transmitters respectively, the use of which has been restricted by the Washington Convention of 1927. Both transmitters employ the well-known balanced valve circuit, which offers the advantage that in the event of one valve and the spare valve being damaged, signals at low power can still be transmitted. A short-range telephone transmitter, suitable for use on board coastal vessels, survey vessels, &c., is shown. This installation is tuned for the marine telephone wave length of 220 m., but it may be tuned to 600 m. and used on I.C.W. Hence a vessel equipped with this type of transmitter can take part in a distress call, and, within the limits

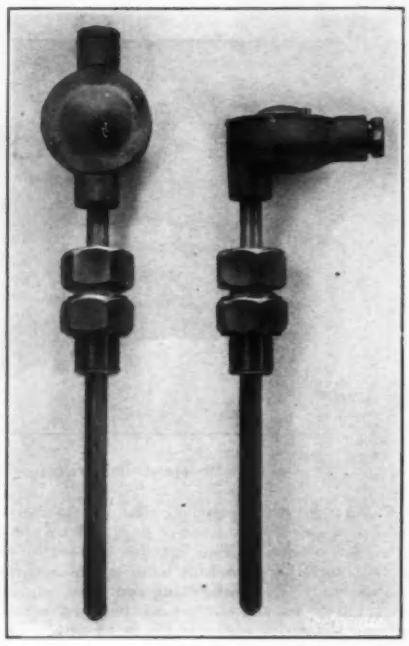


FIG. 33—ELECTRICAL PYROMETERS—SIEMENS

of the range of its apparatus, has the same facilities as are possessed by vessels equipped with more powerful installations.

A small ½-kW quenched spark wireless installation is shown in its modern cabinet form. The use of this size of spark installation is not restricted by the Washington Convention, and it has been re-designed to fulfil the latest demands of the service. The apparatus is completely enclosed in a teak cabinet and complies with all the requirements of the International Radio-

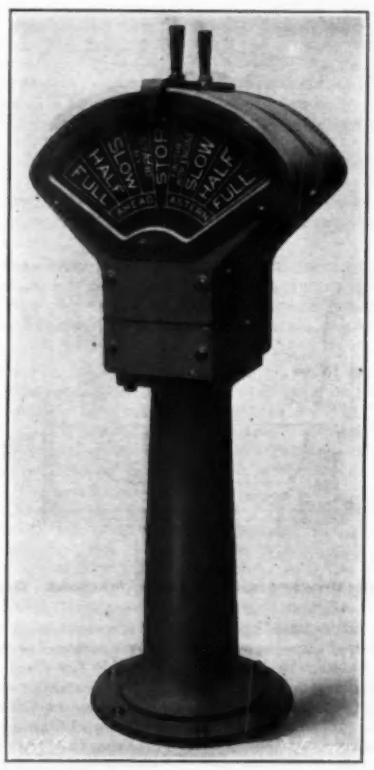


FIG. 34—ELECTRIC SHIP'S TELEGRAPH—SIEMENS

Telegraphic Convention. It is particularly suitable for use on board small vessels, and where a continuous service is not available from the ship's dynamo, it can be worked off batteries. The receiver belonging to the installation can be used on normal commercial wave lengths, and also for receiving the signals sent out on short waves—below 100 m.—by many of the big transmitting stations of the world.

Among the auxiliary apparatus on view is the Siemens patented auto-alarm device, which rings a bell when the alarm signal, consisting of a series of four-second dashes, is received. The instrument is shown working, and is locally operated by a buzzer. By means of a special transmitting key interference

FIG. 35—REVOLUTION INDICATOR—SIEMENS

signals can be generated, and the apparatus thus tested under conditions approximating to those actually found in service.

A single rotating frame direction finder shown is of the firm's latest pattern, as installed on over 100 ships. The aerial is screened, and its leads are led to

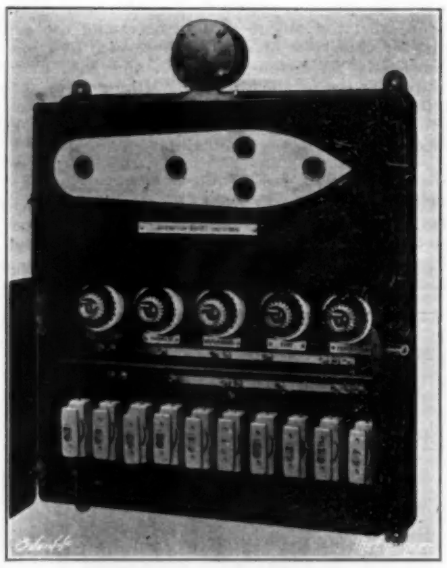


FIG. 36—NAVIGATION LIGHTS INDICATOR—SIEMENS

the receiver through a metal tube, the receiving instruments themselves being completely enclosed in a cast metal non-corrodible metal box.

RADIO COMMUNICATION COMPANY.

This company is exhibiting its latest types of marine radio apparatus for all classes of ships. A ship's cabin containing a complete 1½-kW radio transmitter and receiver gives an accurate idea of the space required for efficient operation. The valve transmitter is of the most recent design for continuous and interrupted continuous waves, and conforms to all national and international regulations governing marine wireless installations. An independent emergency transmitter is embodied in the main transmitter. The two-valve receiver covers a wave range of from 220 m. to 22,000 m., and is capable of receiving from all types of transmitters working on C.W., I.C.W., spark, and telephony. An interrupted continuous wave valve transmitter with a power of ½ kW, specially designed for cargo and small passenger ships, and a wireless installation for lifeboats, are exhibited, also a new radio direction finder for large and small ships. This instrument has been specially designed for installation in chart rooms, and is shown installed in a representative chart room of that description.

An extra frame with its supporting pedestal is mounted on the floor of the stand to afford visitors an opportunity of detailed examination.

An auto alarm for use on ships which do not keep a continuous wireless watch is also on view.

Bull Motors, Ltd.

Prominence is being given by Bull Motors, Ltd., of Ipswich, to arc welding plant, suitable for use on board ship. The illustration—Fig. 37—shows the firm's midget type 100-ampère portable arc-welding set, which is shown in operation, together with the firm's 200-ampère plant. It will be seen that the

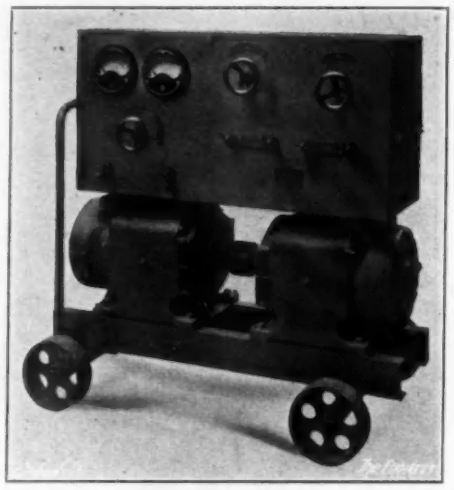


Fig. 37—Portable Arc Welding Set—Bull Motors

midget outfit is very compact. All the control gear is enclosed in a sheet steel cubicle. The control of the generator is obtained by means of shunt and series field regulators, and it is said that welding can be carried out over a current range of from 25 to 100 ampères. Interesting examples of welding work carried out by the "Bull" arc welding sets are exhibited. One of the firm's weatherproof motors is to be seen in operation. The motor drives a pump, which subjects the motor to a continuous spray of water, with the object of demonstrating the suitability of this type of motor for service in exposed situations. Explosion-proof A.C. and D.C. motors, covered by the certificate of the Mining Department of the Sheffield University, and suitable for use in fiery mines, &c., are shown. A high tension D.C. motor generator set is also exhibited.

F. J. Edwards, Ltd.

The stand of F. J. Edwards, Ltd., 406, Euston-road, London, N.W. 1, is characterised by a number of machines for dealing with sheet metal work, and of them we have chosen the shearing machines represented in the half-tone engravings Figs. 38 and 39 and the sketches Fig. 40 for notice.

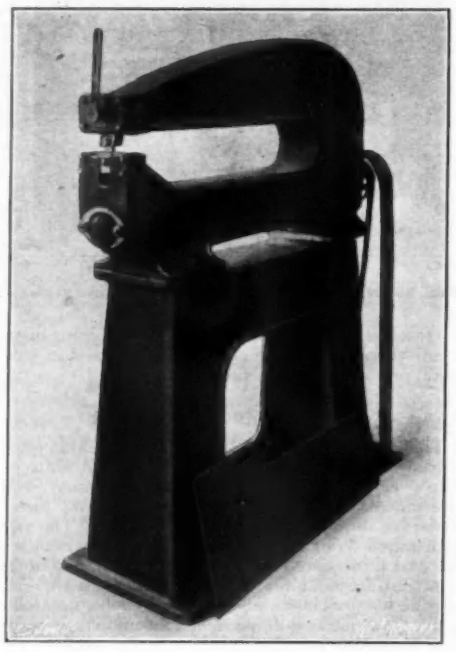


Fig. 38—Universal Shearing Machine—Edwards

The Universal machine—see Figs. 38 and 40—is driven by a ½ horse-power motor and is capable of cutting sheet steel up to No. 14 gauge thick. It works with a true shearing action and has the merit that it will start a cut in the middle of a plate without it being necessary to drill a hole or pierce the plate previously. Again, it has no self-feeding tendency, so that the cut stops precisely where the operator wishes. The shearing mechanism is shown in the upper sketch Fig. 40, from which it will be seen that the top cutter is stationary, when at work, which is a great convenience, as a marked out cut can be easily followed. The cutter is held in a block, which can slide in guides at the end of the main frame and can be raised or lowered by an excentric and handle—see Fig. 38. This excentric has sufficient throw to lift the two cutters clear of one another, so that a plate can be slipped between them and a cut started anywhere. The top cutter is then forced down by the handle to start the cut. In this position the excentric is on its dead centre, so that no further effort on the part of the operator is required to resist the thrust of the shear. The bottom cutter, it will be seen, is mounted on a rocking lever and is reciprocated by an excentric and connecting-rod. An adjustment is provided to set the cutters as they are reduced by grinding. The driving spindle is mounted on ball bearings—see Fig. 40—as is also the connecting-rod. It has two articulations to give it a slight degree of flexibility and to facilitate dismantling. The shaft runs at 1200 revolutions per minute and the stroke of the cutters is between $^{1}/_{16}$in. and $^{3}/_{32}$in. The machine has a gap 30in. deep and weighs approximately 714 lb.

The second machine, Fig. 39, is also an interior

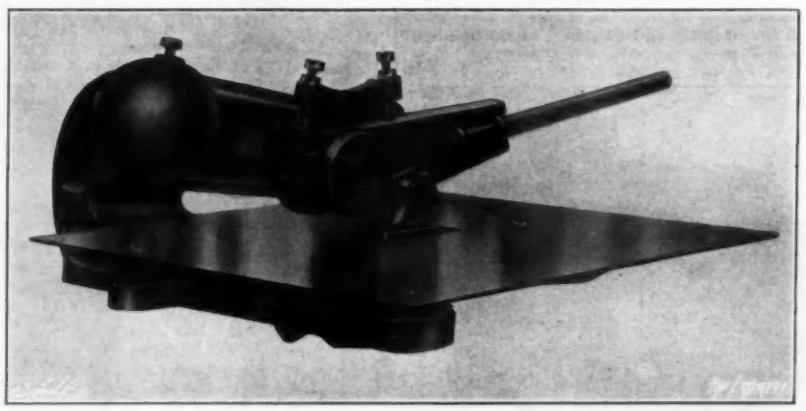


Fig. 39—Hand Operated Internal Shearing Machine—Edwards

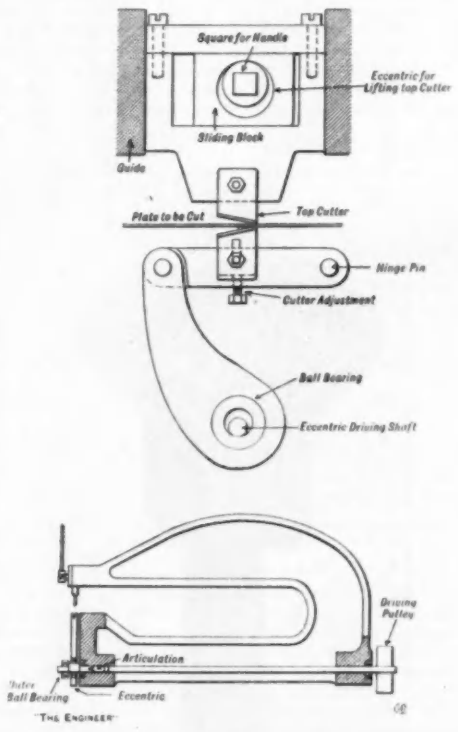


Fig. 40—Universal Shearing Machine—Edwards

shear, but is hand operated, and is intended for service where the expense of the power machine would not be justified. It is specially suitable for those works where stove fronts are made. It is usually supplied as a bench machine, but can, of course, be fitted on a stand. It will cut sheet up to No. 14 gauge thick and has a gap 27½in. deep. The table is 31½in. square. The lever, it will be seen, is counterbalanced and the blade is easily removable for re-grinding. The length of the blade is 4in. A novel feature about this machine is the pair of stops, which can be seen above the head. These stops are adjustable and bear on the top of the lever to restrict its stroke. With these stops the blade can be prevented from going too far down into the work, which is a convenience in going round corners, while it can also be prevented from coming right out and allowing a gap between the blades. In this way, when the work is actually being cut the blades never come apart, and therefore the work cannot slide away inadvertently from the cutting point.

Among the other machines on this stand there is a wheeling and raising machine for taking buckles, creases and dents out of badly shaped rolled or pressed sheet metal. This is specially useful for motor wings and bodies, &c. One top roller and three bottom rollers are normally supplied, but any other shaped rollers can be supplied to special requirements. The machine is fitted with a quick-release action to the bottom roller. This enables the work to be quickly removed and returned again to the same working pressure. This quick release is an improvement which is much appreciated by the users. One motor car manufacturer, the makers tell us, has no less than fifteen of these machines installed for smoothing up motor panels and wings after they come from the presses. There is also an open-ended universal cramp folding machine. The special feature of the machine is the throat clearance at the end, which permits bending at the edge of sheets of unlimited length to a depth of 1¾in. This machine has also an adjustable front beam for making round or sharp bends. It is also fitted with an angle stop at the side, which is very useful for repetition work. Finally, there is a swaging, wiring and jennying machine for hand and power, for which the regular equipment includes twelve pairs of rollers for performing the different operations.

Allen-Liversidge, Ltd.

Oxy-acetylene, electric arc, and electric resistance welding equipments are shown by Allen-Liversidge, Ltd., of Victoria Station House, Westminster, S.W. 1. The oxy-acetylene equipment includes high-pressure welding outfits which employ dissolved acetylene in cylinders, together with compressed oxygen, and low-pressure plant supplied with acetylene from a generator. The illustration, Fig. 41, shows one of the firm's oxy-acetylene welding outfits using oxygen and dissolved acetylene in cylinders. The blow pipe has nine interchangeable tips, and is suitable for welding all sections of metal. Oxy-acetylene outfits similar to the welding outfits, but with a different type of blow-pipe and regulator, are supplied for metal cutting. Mild steel plates 1in. thick can be cut at a speed of about 40ft. per hour, with an oxygen consumption of about 88 cubic feet, whilst the acetylene consumption is considerably less. Dissolved acetylene is also used in combination with air for brazing, soldering, and paint burning, light portable equipments being supplied for these purposes. By the use

Fig. 41—Oxy-Acetylene Welding Outfit—Allen-Liversidge

of a specially constructed blow-pipe and pressure-reducing regulator, it is possible to obtain an oxy-acetylene flame suitable for lead burning, whilst by attaching a suitable fitment carrying a burner and reflector to a cylinder of dissolved acetylene, a powerful stormproof flare light is formed. When supplied from a single cylinder these flare lights, which provide a candle-power of from 1000 to 15,000, according to size, will burn from 8 to 66 hours. They have proved to be of considerable value to builders, contractors, and others engaged on night work out of doors. An interesting subsidiary use of dissolved acetylene is for lighting and cooking on motor boats and yachts, and in small huts and camps. The gas is led from the cylinder through rubber—or, in the case of a more permanent installation—brass tubing, to the lights or stoves. The apparatus is then used just like a gas stove in a town house. No mantles are needed for the lights, and the cooking is done somewhat more quickly than on a coal gas stove. The exchange of empty for full cylinders is, of course, a simple matter and takes only a few minutes.

As we have said, the firm's arc welding and resistance welding outfits are on view. One of the firm's motor generator sets for arc welding is shown in Fig. 42, and it is interesting to note that the bedplate is built up of welded steel girders. The motors driving these sets may be of the A.C. or D.C. type, or the generator may be driven by a belt or petrol engine. Transformers are also supplied for A.C. welding. "Pontelec" resistance welding machines, as shown in Fig. 43, are employed mainly for repetition work, but not necessarily so, on light sections of metal. The following figures show the cost of spot welding with A-L "Pontelec" machines working on clean mild steel plates and on good quality mild steel pickled sheets :—

Clean Mild Steel Plate.

Single metal thickness.	Total aggregate thickness, inches.	Welds per unit, approx.	Time of each weld in seconds.	Diameter of spot, inches.	Approx. cost of 100 welds at 1d. per unit.
S.W.G.					Of 1d.
34	·0184	4800	·25	1/16	1/48
28	·0296	3400	·3	1/16	1/34
26	·036	1800	·5	1/8	1/8
24	·044	1450	·5	1/8	2/29
22	·056	1200	·6	1/8	1/12
20	·072	1000	·6	1/8	1/10
18	·096	850	·7	1/8	2/17
16	·128	750	·8	3/16	2/15
14	·160	515	1·0	3/16	20/103
12	·208	360	1·25	3/16	5/18
10	·256	240	1·5	3/16	5/12

Mild Steel Pickled Sheets.

Gauge No.	Thickness in inches.	Max. kW.	Welding speed in feet per minute.	Units consumed per 100ft.
34	·0092	4	10	·66
28	·0148	6	8	1·25
24	·022	8	6	2·2
22	·028	9½	6	2·6
20	·036	12	4	5
18	·048	15	3	8·25
16	·064	18	3	9·9
14	·08	20	3	11
12	·104	25	3	14
10	·128	30	3	16·5

THE BRITISH OXYGEN COMPANY, LTD.

On the stand of the British Oxygen Company, Ltd., of Angel-road, Edmonton, there is a large variety of apparatus for cutting and welding metals by means of the blow-pipe, most of which is familiar to our readers. The collection includes hand oxygen metal cutters for sections ranging from the lightest gauges up to 20in. thick in steel and cast iron, oxy-acetylene welding blow-pipes of both injector and high-pressure types for all sections from 22 B.W.G. up to 1¼in. thick, and oxy-coal-gas brazing, lead burning and heating blow-pipes. There are also several automatic and hand-operated oxygen metal-cutting machines, most of which we have already described. These machines include little units for repetition work and others for such heavy jobs as cutting out locomotive frames.

One of the most interesting exhibits is the latest type of Shorter hardening machine, the prototype of which was described in THE ENGINEER of December 17th, 1926. This machine, it will be remembered, was originally devised for hardening the surfaces of the teeth of steel gear wheels by a process of heating them intensely and locally, by means of an oxy-acetylene blow-pipe, and immediately cooling the heated surface by a water jet. The result is a layer of hardened steel on the surface of the tooth, while its root retains the tough normal condition, as the rapidity of the process does not allow the heating effect to penetrate far into the metal. The flame of the blow-pipe is directed against the pitch line of the teeth and naturally it is there that the greatest depth of hardening occurs. On either side the hardening effect fades away, while it also fades into the body of the tooth, so that there is no tendency for the hardened surface to flake away from the body. The core of the tooth is of pearlitic steel, while there is a gradual transition, through sorbite to martensite, at the surface.

The great merit of the process is that the heating is so local, and so rapid, that there is no chance for the body of the piece being treated to become generally heated, and consequently it is not distorted by internal stresses.

The machine shown at Olympia is one of an improved type developed to increase operating facilities, and to simplify the plant required for carrying out the process. The improvement consists largely of a modified operating head, which is lighter in movement and which can be positioned over the tank as required for the purpose of hardening different types of gear wheels and other articles. It also obviates the necessity for the turntable bearings used in the original plant. The new machine is also provided with an apparatus for driving the spindle, thus enabling a variety of articles to be surface hardened with the same facility as in the standard machine. The most recent development of the "Shorter" process has been its application to articles other than gear teeth. Various means have been provided to enable some of the most intricate machine parts to be satisfactorily surface hardened. During recent months the Patent Gear and Metal Hardening Company, Ltd., has applied the process to spindles, rollers, and other cylindrical pieces, in some cases covering very large superficial areas, as in the case of rollers. One interesting achievement has been in the hardening of several cams, 21in. in diameter, with a 3in. face. Another development is the application of the process to crank shafts for motor cars to harden the pins and journals without distorting the shaft in any way. Improvements have been effected in the burners used for heating purposes, and also in the methods of quenching. These changes have largely been effected with the object of meeting the demand for applying the process to articles of peculiar shape and those too difficult to deal with with the ordinary type of apparatus.

There are also on this stand a number of castings made by the pressure die cast process in zinc base, tin base and aluminium alloys. There are also "Prana" non-rusting plaited hose covering for armouring rubber tubing and an asbestos covered rubber tubing, armoured with steel braiding, for use in high-pressure work and in oxy-acetylene welding and cutting.

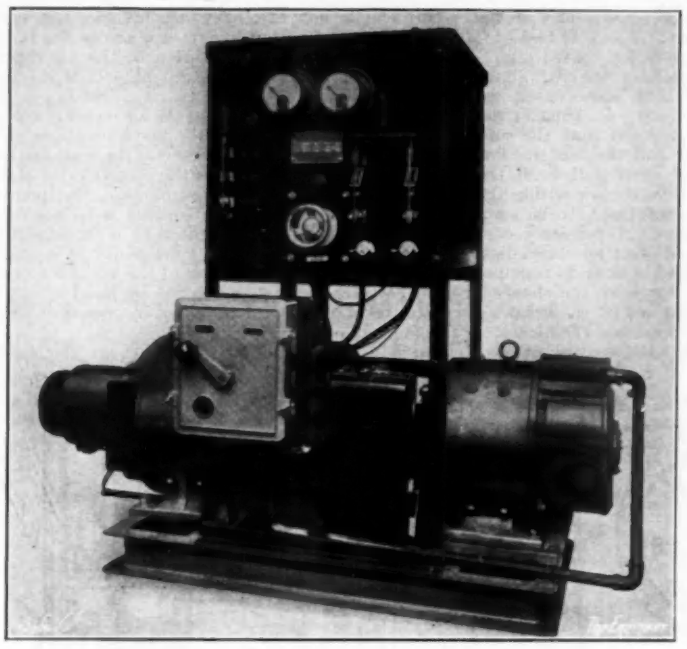


FIG. 42—ELECTRIC ARC WELDING SET—ALLEN-LIVERSIDGE

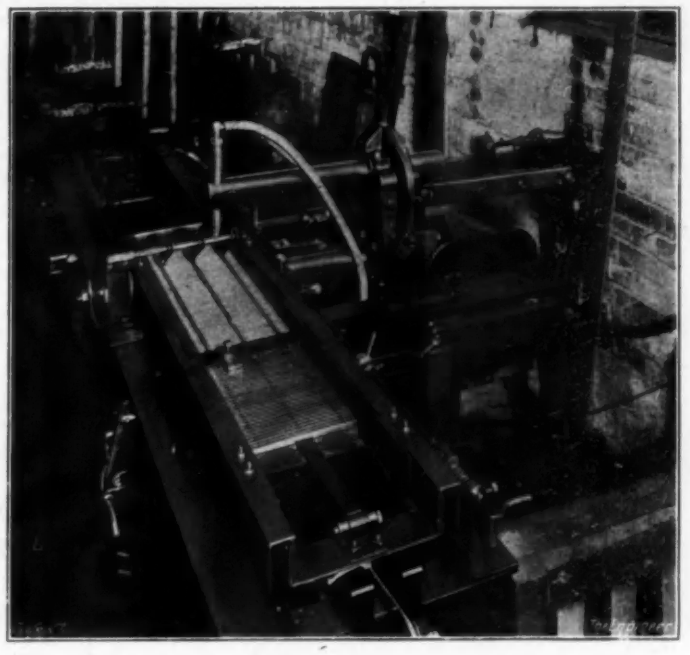


FIG. 43—AUTOMATIC SPOT WELDING MACHINE—ALLEN-LIVERSIDGE

THE RAPID MAGNETTING MACHINE COMPANY, LTD.

We have, on several previous occasions, referred to the products of the Rapid Magnetting Company, Ltd., of Lombard-street, Birmingham, and it is consequently unnecessary to enlarge upon the principle of high magnetic flux which determines the efficiency of these machines for the extraction of ferrous metal, or rather material which has any magnetic quality, from a general gangue. There are, however, on the stand of this company several machines that appeal to us on account of their compactness, and of these we illustrate—in Figs. 44 and 45—a machine which combines the characteristics of drum and chute separation.

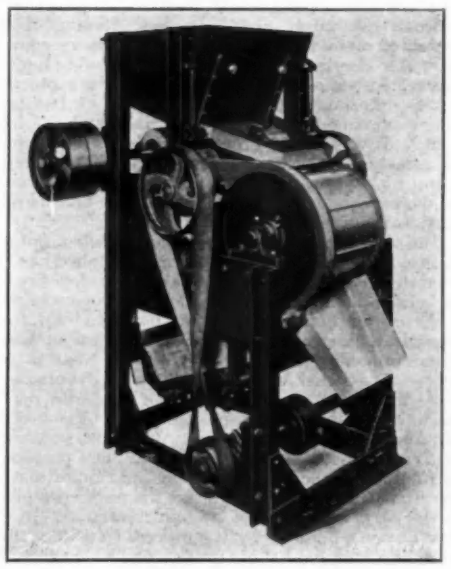


FIG. 44—MAGNETIC SEPARATING MACHINE—RAPID MAGNETTING

The material to be separated, such as the general sweepings from a machine shop floor, or the swarf collected from the machines, is dumped into a hopper, plainly shown at the top of our illustrations. This hopper has an adjustable outlet and discharges the material on to a jig shaker feed tray, that delivers an even stream of material on to a rotary drum. This drum is equipped with electro-magnets which are energised during only a period of the revolution of the drum, with the result that all non-magnetic material is roughly classified off down the chute shown to the right of Fig. 44, while the remaining magnetic stuff, such as iron turnings and filings, is carried

forward by the drum until it is released, by the breaking off the electro-magnetic circuit in the drum, to fall on to the chute plainly shown in Fig. 45.

In view of the fact that the detritus from the drum may contain some small proportion of entrapped iron, it is then passed over an inclined chute equipped with a series of five intense transverse magnetic poles. This jig is vibrated by an excentric driving system, and results in the detention of any remaining iron. This iron is held by the magnets, and is occasionally cleaned off when the electric circuit is interrupted. It is noteworthy that all the shafts of this machine

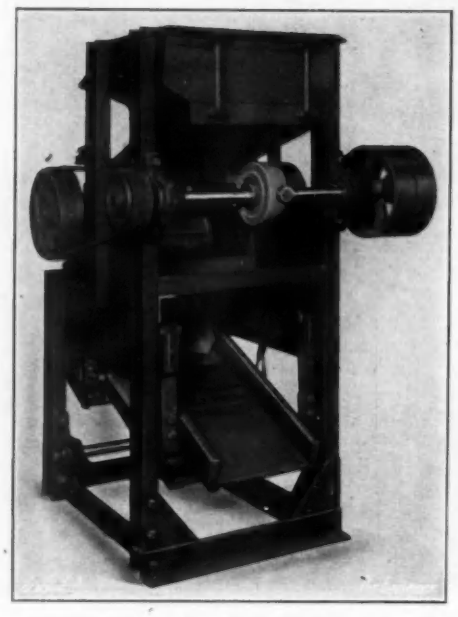


FIG. 45—MAGNETIC SEPARATING MACHINE—RAPID MAGNETTING

are supported in ball bearings of the dust-proof, self-aligning type, that the excentrics are balanced, so as to minimise vibration of the main frame, and that grease-gun lubrication is adopted for all the moving parts. These machines range in width from 6in. to 24in., and consume from 235 watts to 785 watts.

FESCOL, LTD.

The firm known as Fescol, Ltd., was originally named the Fletcher Electro Salvage Company, Ltd., and dates its inception from some experiments carried out before the war with the object of developing improved processes for the electro-plating of metals. The primary object sought was the discovery of a process that would give increased adhesion of the deposited metal to the base metal. It was recognised that the electro-deposition of metals as ordinarily carried out, failed to give a satisfactory protection against erosion or corrosion, because of the poor union existing between the deposited and the base metal. It was further argued that if that union could be greatly improved, it would be possible to apply metal by deposition to any degree of thickness, even to the extent of building up parts that had become very badly worn.

The object sought was eventually achieved, but the precise manner in which the process is applied has not been disclosed to us. The metal chiefly deposited is nickel, and can be applied either for protective purposes or for building up worn parts on cast iron, wrought iron, steel, phosphor bronze, aluminium and aluminium alloys, and other metals. Next in importance to nickel and with important advantages in some instances, the "fescolisation" process makes use of chromium as the deposited metal. The process can also be worked with cobalt, pure iron, cadmium, and copper as the deposited metal. The process is carried out in the cold, and therefore cannot distort the parts treated by it nor affect the properties given to the parts by any previous heat treatment. In the case of parts built up by the process to restore their worn surfaces, only those portions which have to be repaired are exposed to the treatment. For example, in the repair of an armature shaft, the windings may be left undisturbed while the bearings are being restored by the Fescol process of electro-deposition. After the metal has been deposited to the required thickness, the deposited surface is machined or ground.

Tests conducted at the National Physical Laboratory show that steel coated with nickel by the Fescol process has a greater hardness than the same steel when uncoated. The steel in the natural state had a Brinell number of 298, whereas in the coated condition the number was 349–377. The thickness of the coating on the test specimens was about 0·04in. The Laboratory also conducted tests to determine the adhesion of the coating to the steel. A steel rod, 1in. diameter, screwed $\frac{3}{4}$in. Whitworth at one end, was coated with nickel at the other end, the deposition being continued until a nickel collar $1^5/_{32}$in. in diameter and 1in. in length was formed on the bar. This collar was screwed to 40 threads per inch. A testing machine holder was screwed on to the nickel collar and another on to the $\frac{3}{4}$in. steel end of the specimen. The piece was then inserted in the testing machine and an increasing pull applied to it. Under a load of 10 tons the adhesion of the nickel to the steel remained intact. The nickel collar was then cut down from its original length of 1in. to a length of 0·215in. Under a load of 11·95 tons the collar was pulled off the steel. The adhesion area of the nickel in this test was 0·675 square inches. Consequently, the breaking load per square inch of the adhesion surface was 17·6 tons. A similar test conducted at the Laboratory on a nickel coated aluminium specimen showed a breaking load of about 3 tons per square inch. In both these cases, we gather, the failure resulted from the shearing of the base metal within the collar, and not from the rupturing of the bond between it and the nickel. For example, after the collar had been pulled off the aluminium specimen, the adhesive surface within the nickel ring was found, we are informed, to be completely covered with aluminium. A privately conducted test on a nickel-coated steel specimen has, we learn, yielded a breaking load of over 24 tons per square inch. The failure occurred by the shearing of the skin of the steel core and not by the breaking down of the bond between the steel and the nickel.

It is interesting to learn that the coating of steel with nickel by the Fescol process has a slight effect on the tensile strength of a specimen. An untreated steel specimen, 0·8in. in diameter, showed a yield stress of 52 tons per square inch, and an ultimate stress of 60 tons. A similar specimen uniformly coated with nickel gave a yield stress of 47·7 tons and an ultimate stress of 56 tons. There was also a slight decrease in the percentage elongation. Comparative tests were made to determine how far the fescolising process affected the properties of the steel itself. An untreated specimen was tested against a similar treated specimen, which had had the nickel deposit removed by grinding. In both cases the elongation was 40 per cent. The untreated specimen showed an ultimate stress of 32 tons per square inch. The treated specimen gave a figure of 30·3 tons.

Nickel, it may be added, is relatively inactive chemically to many agents, and, in addition, when deposited by the Fescol process shows a remarkably low coefficient of friction. When tested with the Herbert pendulum hardness tester, it is found, we learn, that a steel specimen fescolised with nickel exhibits a work hardening figure as high as that of unmachinable manganese steel. In spite of this fact, the nickel surface can readily be machined.

GEORGE KENT, LTD.

Among the exhibits on the stand of George Kent, Ltd., Luton, the combustion efficiency meter illustrated in Fig. 46 is being shown for the first time. The principle of this meter is based on the assumption that the efficiency of a boiler is constant at all loads, and therefore that for correct efficiency the quantity of air supplied to the furnaces should be proportional to the evaporation. This assumption may not be academically correct, but the makers state that for practical purposes it has been found to give a very good approximation to the truth.

The meter consists of two primary parts, namely, a steam flow meter giving the output of the boiler, and an air flow meter giving the air supplied to the furnaces. The steam flow meter, situated at the top of the instrument, is fitted with a pointer and scale indicating the flow of steam as a fraction of the full flow. The air flow meter is of the inverted ball type, and measures the drop in pressure across the boiler baffles, which drop is a function of the air supply to the boiler. A link mechanism, the details of which can be followed in the engraving, combines the motion of the steam meter and the air meter in such a way as to show the ratio of the two indications on a scale near the foot of the instrument, the scale marked "Correct air supply." When the correct ratio of the air supply to the steam flow obtains, the pointer reads zero. The combining linkage is so arranged that an excess of air is indicated by a movement of the pointer to the right and a deficiency by a movement to the left. The setting of the pointer to give a correct zero reading is effected by hand after the correct ratio has been determined by means of a flue gas analysis.

On a circular clock-driven chart at the centre

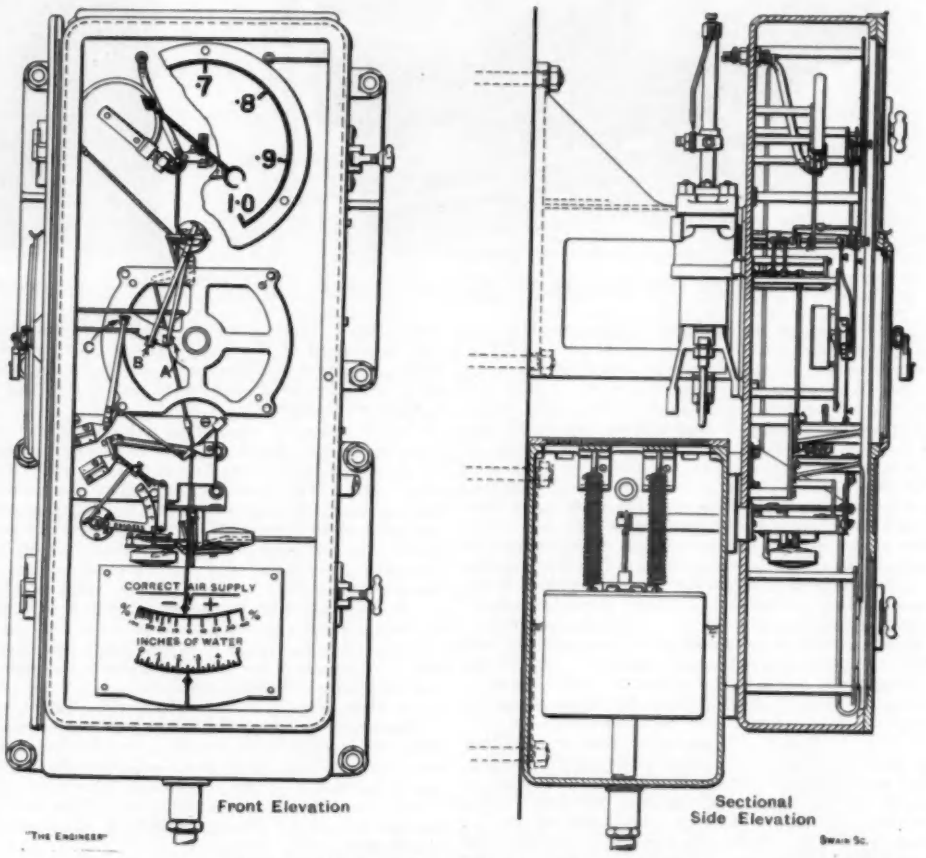


FIG. 46—COMBUSTION EFFICIENCY METER—KENT

of the instrument three pens A B C are arranged to operate. The pen A gives a record of the steam flow and the pen B a record of the air-to-steam ratio. The third pen C gives a record of the flue gas temperature and is operated from a nitrogen thermometer. Below the air-steam ratio scale at the foot of the instrument is a scale on which the flue draught in inches of water is indicated.

The meter, as illustrated in our engraving, is suitable for bolting to stanchions or to a wall. It can also be supplied, if desired, for mounting on a pedestal. The makers inform us that in practice the meter has given highly satisfactory results, and that it has been found to give information about the combustion very much more quickly than does a CO_2 recorder.

THE LEA RECORDER COMPANY, LTD.

There are on the stand of the Lea Recorder Company, of 28, Deansgate, Manchester, several apparatus, such as the Cubimeter, for measuring the flow of coal to a furnace or the discharge of clinker and ashes from the ashpan, while there are several forms of water meter. Among the latter one of the most interesting types is that illustrated in Figs. 47 and 48, which is designed for the registration of the flow of streams subject to flood. For this purpose a compound weir is utilised, the small flows being measured by the height of fall over a V notch, while the flood is measured over a plain straight weir. Their relative arrangement is plainly shown in Fig. 47. In order to make a continuous chart of the flow, regardless of its amount, the float rod A—see Fig. 48—is connected with the drum B, on which there is cut a scroll that has a variable pitch corresponding with the variations

in the flow coefficients of the V notch and the plain weir. Above this drum there is a slide bar C on which there slide two integrating units D and E in unison. These units work in conjunction with two integrator drums F and G, which are driven by the clockwork H. The teeth on these drums are cut away in the form of a helix in the familiar fashion of other Lea recorders. The positions of the several parts is such that the unit D comes out of engagement with its drum, in sliding along the bar C, at the same moment as the unit E engages with its drum, and this point corresponds with that on the scroll drum B where the pitch of the helix changes from that representing the V notch flow to that of the plain weir flow. Attached to the carriage of the integrator drums there is a pen arm J which traverses a chart drum K and produces a curve that represents the momentary flow over the weir.

The action of the apparatus may be followed by the following example, in which, however, a rectangular notch takes the place of the V notch. The weir in this case is intended to deal with a normal flow up to 4½ million gallons per day, while the second integrator is intended to range from 4½ million gallons up to 200 million gallons per day. The measuring plate, through which the flow passes, provides a narrow rectangular notch 4ft. wide by a little over 9in. deep, while for the abnormal flow the notch expands to 20ft. wide, in which a depth of about 3ft. 8in. represents about 200 million gallons per day. The toothed drum F of the first integrator is about 4in. long and the first range of the groove of the proportioning drum B is formed to give this traverse. Therefore this first portion of the helical groove provides a movement of 4in. for a corresponding variation of depth up to 9in., and in direct proportion with the rate of flow and not of the depth of flow. The toothed

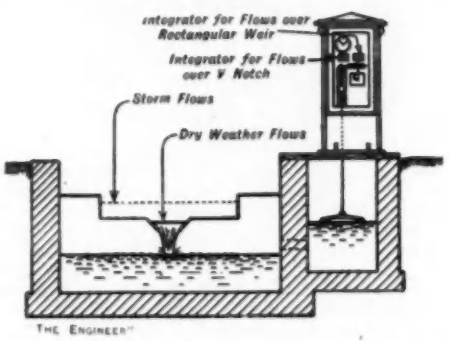


FIG. 47—FLOOD AND NORMAL FLOW GAUGE—LEA

drum of the second integrator is about 8in. long, and this traverse is provided by the second portion of the helical groove, which is shaped to give such traverse corresponding to a variation in depth from just over 9in. to about 3ft. 8in., representing in direct proportion a variation from 4½ million to 200 million gallons per day. In further explanation of the helical groove the following figures are of interest, namely, those of the actual distances traversed, representing depth increases from 8in. to 9in. and from 10in. to 11in., as, bearing in mind that the drum receives the same angular movement in each case these figures will be an indication of the change of gradient of the groove. The traverse representing 8in. to 9in. is approximately $\frac{1}{32}$in., while that representing 10in. to 11in. is approximately $\frac{5}{64}$in. Thus the depth scale on the chart is considerably more open for the normal flow than for the excess, while as regards area, on the normal part of the chart 1 square inch represents 414,474 gallons and in the excess area 1 square inch represents 9,003,290 gallons.

Corresponding with these figures the integrators may be identical and in each the unit will be of different value in gallons, or the integrators may be different so as to register in equal units. When the flow is within the normal range the first integrator D is in operation and records the total volume, being moved relatively to its toothed drum F in proportion to the rate of flow. At the same time the pen of the recording chart moves within the first range of the chart, the movement of the integrator and pen being effected by the first part of the groove on the proportioning drum B. When the flow is above the normal range it spreads the full width of the larger passage, as well as completely filling the normal flow passage, and simultaneously with such spreading the proportioning device reaches the second part of its groove and the integrators reach a position where the first integrator becomes disengaged and the second integrator comes into engagement. The second integrator records the total flow during flood level only, while the first integrator records all normal flow, *i.e.*, up to flood level. Simultaneously with the change over of the integrators to the flood recording the recording pen crosses the dividing line of the chart into the second range so that from the chart the total flood flow, *i.e.*, that in excess of the maximum normal flow, may be ascertained from the area within such second range as distinct from the total flow during flood which is recorded on the second integrator, in which is included the rectangular area in the first range below the area in the second range of the chart.

The chart is preferably ruled so that the areas of figures thereon may be calculated in even figures, as, for example, longitudinally to represent periods of three hours with heavy lines to mark mid-day and midnight, and circumferentially to represent rates of flow, as, for example, for the normal flow area to show divisions representing 100,000 gallons per day. Consequently the areas bounded by such lines in the two ranges of the chart represent 12,500 gallons and 250,000 gallons respectively. The chart is also preferably lined circumferentially in a different colour to show depth of flow corresponding to the rate of flow, which lines, in contradistinction to those of the rate of flow, are unequally spaced, the spacing becoming wider as the depth increases; but, as already explained, there is a considerable change or

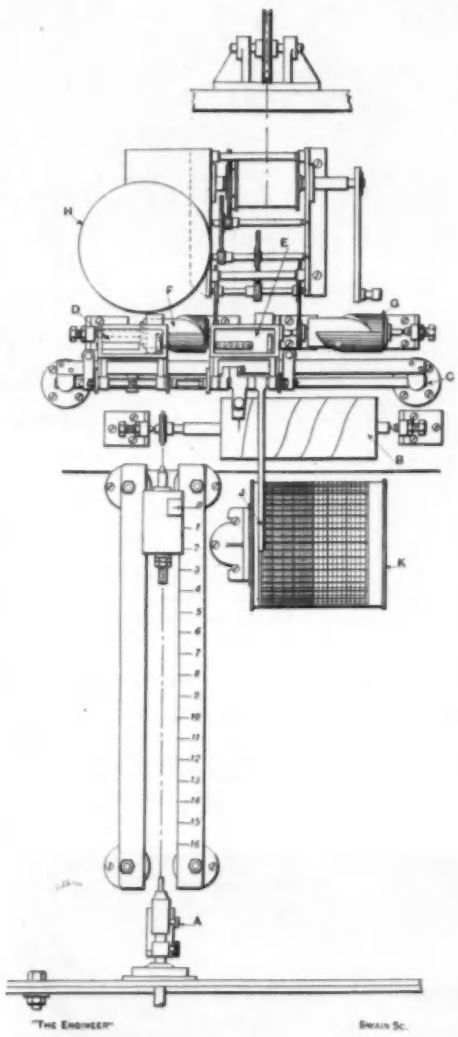


FIG. 48—RECORDER OF FLOW GAUGE—LEA

closing of such spacing after the head rises above the flood line.

THE CAMBRIDGE INSTRUMENT COMPANY, LTD.

Most of the instruments exhibited by the Cambridge Instrument Company, Ltd., of 45, Grosvenor-place, S.W. 1, have been described in previous articles and Supplements which we have published on various exhibitions, held in the past. Briefly the company's exhibits consist of a representative collection of instruments for ships and engineering works, including electrical CO_2 and CO indicators and recorders, apparatus for recording the percentage of dissolved oxygen in boiler feed water, draught and pressure gauges, temperature measuring instruments, automatic temperature regulators and other instruments for engineering and electrical measurements. Typical groups of instruments are mounted on panels, as they would be installed in a vessel or power station. For example, one panel comprises two totally enclosed indicators arranged for connection to a number of electrical distance thermometers measuring oil, water, and air temperatures throughout a turbine and condenser plant. The panel also accommodates a pressure recorder, for measuring the pressure at the stop valve on the boiler side, and a compound gauge for measuring the pressure at the turbine exhaust.

Limitations of space will not allow us to do more than describe in detail the firm's hydrostatic type of temperature regulator, which has been designed for controlling the temperatures of tanks or chambers between the limits of — 10 deg. Fah. and + 550 deg. Fah., or — 20 deg. Cent. and + 290 deg. Cent., and which may be used in certain cases instead of the more expensive type of Cambridge regulator. It may be employed to control the flow of steam, gas, air, oil, or water. As a temperature regulator the instrument has been found useful for the regulation of the temperatures in heating systems for factories, bacteriological laboratories, hotels, steamships, &c., in calorifiers, milk pasteurisers and sterilising tanks, in cooking and drying chambers, in vulcanising pans, and liquid sulphur tanks for india-rubber processes, in size baths or textile taping machines, in dyeing vats, in oil baths for the heat treatment of steel, in bottle washing machines, in gas heated ovens for bakeries, in drying ovens and enamel stoves, in oil refining stoves, and in timber drying stores.

A valve in the steam supply pipe or other heating system is fitted with a diaphragm chamber, as shown in Fig. 49, and is arranged so that when water pressure is applied to the diaphragm the valve closes and the supply of steam is cut off. Alternatively the diaphragm can be arranged so that the valve opens when the water pressure is applied and closes when the pressure is reduced. The water pressure is applied through the regulating device shown diagrammatically in Fig. 50, which is controlled by means of a vapour pressure thermometer of the dial type. This thermometer has a dial 4in. in diameter with a

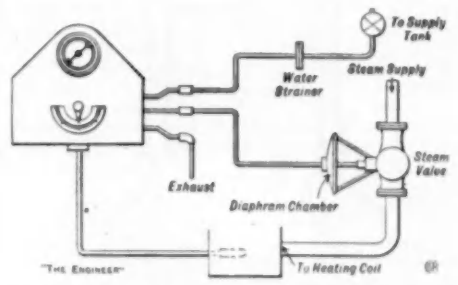


FIG. 49—TEMPERATURE REGULATOR—CAMBRIDGE

scale approximately 8½in. long, and the graduations are in white on a black background, so that they are clearly defined and may easily be read. The bulb G of the thermometer, which is exposed to the temperature to be controlled, is connected by capillary tubing T_1 T_2 to two pressure tubes in parallel, one of which is connected to the dial pointer, thus indicating the temperature, while the other tube A is connected by a link B to a lever C which is pivoted on the diaphragm D and projects inside the chamber E. At the end of the lever there are two flat springs fitted with pads F, which form valves at the ends of pipes H K connecting the chamber E to (*a*) the water supply, and (*b*) an outlet for the waste water. A third pipe L connects the chamber E to the diaphragm valve.

When the temperature of the tank or other device being controlled is below the point at which it is to be regulated, the pressure tube A takes up the position shown in the diagram, with the inlet or supply pipe H closed and the outlet K open. There is, therefore, no water pressure on the diaphragm, and the steam valve opens, thus allowing the supply of heat to pass to the

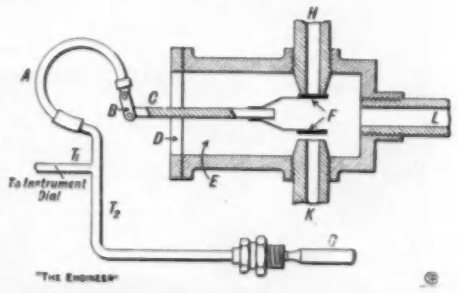


FIG. 50—TEMPERATURE REGULATOR—CAMBRIDGE

tank. As the temperature rises the lever C is tilted so as to close the outlet pipe K, and if the temperature rises still further, so that the critical point is passed, the inlet pipe H is opened, admitting the water to the diaphragm under pressure and closing the valve. In practice, when the control temperature is reached, the lever C takes up a position such that both inlet and outlet pipes are practically closed. The diaphragm valve is thus held in such a position that the right amount of steam or other heating medium is constantly supplied, and the valve will only be wide open or fully closed when sudden temperature changes have taken place. The water pressure which is required to work the diaphragm valve satisfactorily must be at least 10 lb. per square inch. A reasonable, steady pressure is also necessary for the best results, and if the water pressure available fluctuates largely a tank should be installed about 20ft. or more above the regulator to give a constant pressure. Alternatively a reducing valve fitted to the main supply may be used or the diaphragm valve may be operated by compressed air.

The temperature at which the regulator operates may be adjusted by rotating a handle situated below the dial of the thermometer. A pointer attached to this handle moves over an evenly divided scale, and by this means the apparatus can be set at any time to the desired point of control. The regulator can be adapted to operate large valves requiring a con-

siderable amount of power, and in this case the diaphragm valve is replaced by a cylinder and piston.

CLARKSON THIMBLE TUBE BOILER COMPANY, LTD.

The exhibit which has been staged by the Clarkson Thimble Tube Boiler Company, Ltd., of Australia House, W.C. 2, has been designed to illustrate the special heaters and boilers constructed by the company for the recovery of waste heat from the

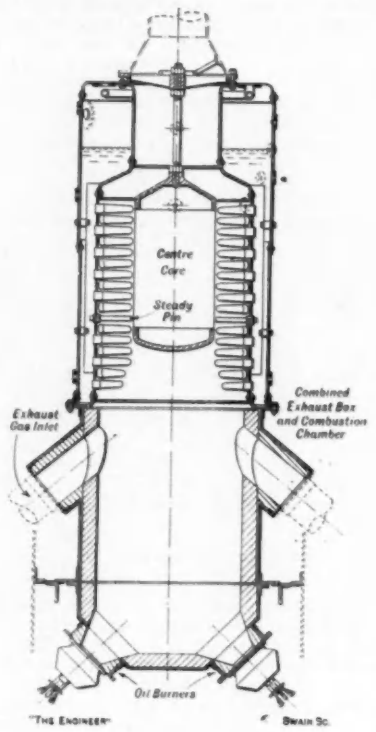


FIG. 51—EXHAUST GAS BOILER—CLARKSON

exhaust gases of four-stroke and two-stroke land and marine oil engines. The actual apparatus shown is a sectional heater of return flow type in which the exhaust gases enter through a central tube, and after passing to the top of the heater descend through a nest of thimble tubes, and are then discharged to atmosphere. The sectioning enables the construction of the heater to be inspected, and the relative paths of the water and exhaust gases distinguished. In this type of heater no steam space is necessary, and the usual boiler fittings are done away with. In THE ENGINEER of April 15th, 1927, we published an account of an investigation into the efficiency of such a heater by Professor G. Cook, of King's College. On the stand there is also displayed a series of sectioned thimble tubes cut from boilers in actual service. The exhaust gas boilers which are now becoming almost a standard fitting in modern motor vessels are illustrated by a number of photographs and installation drawings. From these we have chosen for reproduction a drawing of a typical exhaust gas boiler fitted on four of the motor vessels of the Norfolk and North American Steam Shipping Company, Ltd. (managers, Furness, Withy and Company, Ltd.). These boilers are designed to deal with the exhaust gases from Kincaid-Harland-B. & W. four-stroke single-acting engines of 4000 B.H.P. As our illustration—Fig. 51—shows, the boiler is divided into two parts, the upper portion being the boiler proper. This has a diameter of 5ft. and a length of 8ft. 9in., while immediately below is a combustion chamber, a further 7ft. in length, which accommodates the exhaust gas inlets from the two engines and also the two oil burners. This type of boiler may be taken as being generally typical of the firm's marine practice. An installation recently completed which is of particular interest is that on the 15,600-ton, 12-knot oil tanker "Calgarolite," which was built by the Furness Shipbuilding Company, Ltd., for the Imperial Oil Company, Ltd., of Toronto. The vessel is propelled by two 2500 B.H.P. two-stroke, single-acting Krupp engines. Each boiler—see Fig. 52—is designed to deal with the exhaust gases from one engine and to generate 1000 lb. of steam at 100 lb. per square inch pressure, with an entering exhaust gas temperature of about 500 deg. Fah. Owing to the cooling effect of the scavenge air in a two-stroke engine, this temperature is considerably lower than that in a four-stroke engine of equal power. On the sea trials of the "Calgarolite," with the engines running at 90 r.p.m., the evaporation from the starboard boiler was 796 lb. per hour, with an exhaust inlet temperature of 495 deg. Fah., while 752 lb. of steam per hour were raised in the port boiler with an entering exhaust gas temperature of 426 deg. Fah. In other trials, both boilers produced 1850 lb. of steam per hour, with the main engines working at full output. The silencing effect of the boilers was also remarkably good. As recorded in THE ENGINEER for August 9th, there are to be five Clarkson thimble tube exhaust gas boilers fitted in the new White Star liner "Britannic." The designed output of the main engines on this ship is 20,000 S.H.P. and two exhaust gas boilers will be provided for each of the two main 10,000 S.H.P. engines; an auxiliary exhaust gas boiler, which will work in conjunction with the auxiliary generator engines when in port, will also be supplied.

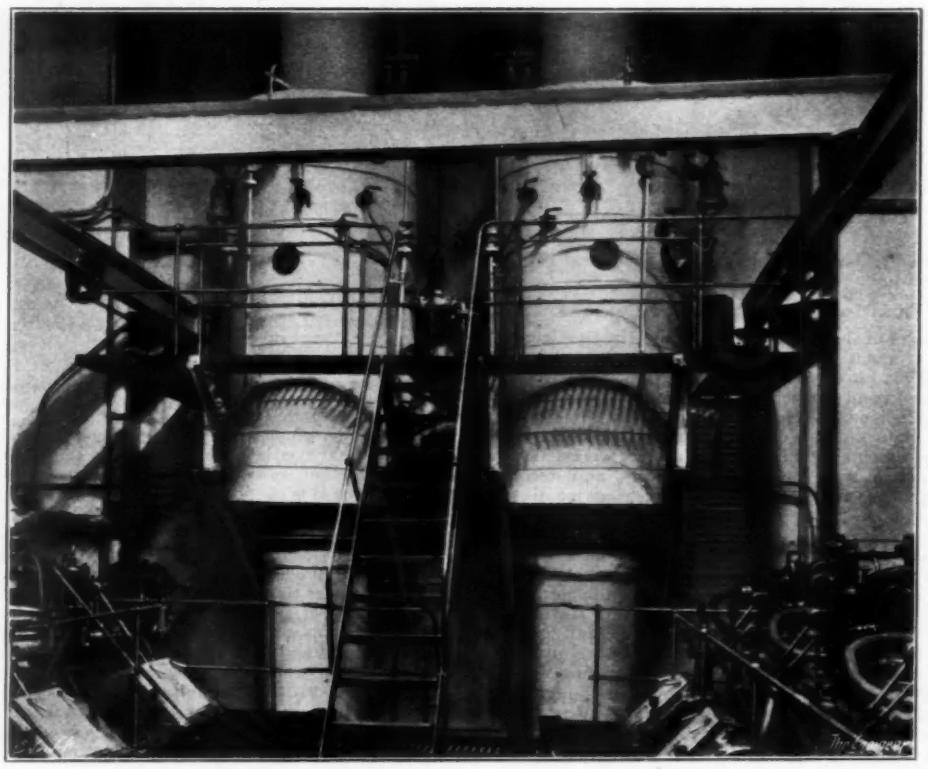


FIG. 52—EXHAUST GAS BOILERS ON M.V. CALGAROLITE—CLARKSON

WINGROVE AND ROGERS, LTD.

For use in factories, warehouses, at docks, and on railway stations, Wingrove and Rogers, Ltd., of Old Swan, Liverpool, have developed a petrol engine driven truck, which is being exhibited for the first time. A great deal has been written on the relative merits of petrol and electric vehicles for factory, road and other services, but it is probably now pretty well agreed that the two types of vehicles have their own spheres of usefulness. The electric truck, Wingrove and Rogers contend, is more expensive to buy than the petrol truck, but the wear and tear is very much less. Although the initial cost of the the petrol truck is less than that of the electric truck, it does not last nearly so long as its competitor. Over a period of, say, ten years, the electric truck will, this firm maintains, undoubtedly prove cheaper than the petrol vehicle, but owing to the absence of charging facilities or to the excessive price of electricity, there are many places in which electric trucks cannot be employed.

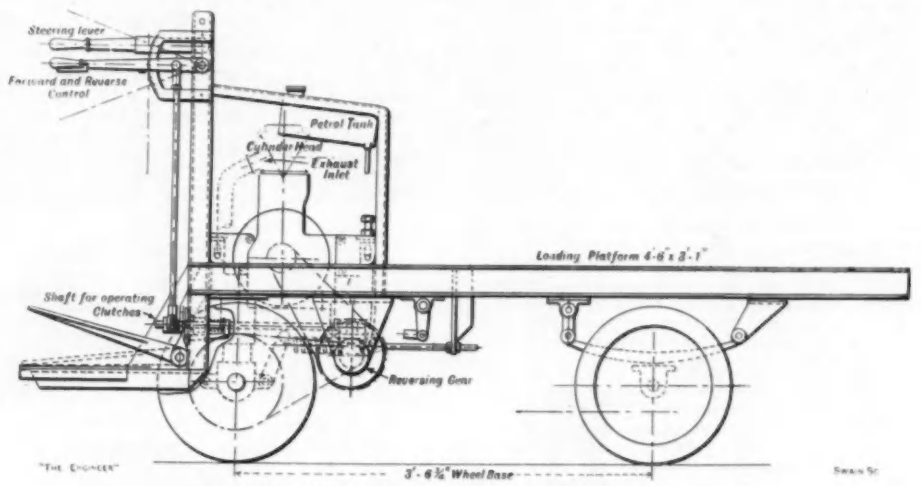


FIG. 53—ONE-TON PETROL-DRIVEN TRUCK—WINGROVE

It has always been admitted that for certain purposes petrol trucks offer definite advantages. Wingrove and Rogers have, therefore, decided that it is essential to be in a position to offer both types. The 1-ton petrol truck that has been developed by this firm is shown in the drawing, Fig. 53, from which it will be gathered that the general arrangement is similar to that of an electric truck. The chassis is composed of mild steel channel sections, and is sprung at the driving axle end by two strong spiral springs, and at the steering axle by two semi-elliptic leaf springs. The wheels are fitted with solid 16in. by 3in. rubber tires, and are all mounted on double row ball bearings. An overhead valve air-cooled engine is mounted directly above the chassis at the control end, and is contained in an adequately ventilated steel plate housing. The power is transmitted by means of roller chains to a countershaft, with reversing gear and a friction clutch all in one self-contained unit. Special pains have been taken in the design of the vehicle to secure easy control. Apart from the foot brake, the driver has only to deal with one controlling handle and the steering handle. The speed is from 5 to 6 miles per hour.

FIG. 54—TWO-TON ELECTRIC TRUCK—WINGROVE

The firm is also exhibiting its 2-ton super-giant electric truck, shown in Fig. 54. The speed of this truck is 5 miles per hour; the radius of action per charge, 15–20 miles; the loading space measures 7ft. 6in. by 4ft.; the platform height is 2ft.; the ground clearance is 3½in.; and the turning radius to the centre of truck, 7ft.

THE TELEPHONE MANUFACTURING COMPANY.

Perhaps the most interesting exhibit of the Telephone Manufacturing Company, Ltd., of Hollingsworth Works, West Dulwich, is the "Laryngaphone" noise-excluding telephone, by means of which speech can be transmitted and received clearly in the noisiest surroundings. To obtain this object, advantage is taken of the fact that speech is the result of mechanical vibrations of the vocal cords. These vibrations are picked up by the Laryngaphone microphone, which is applied to the neck or cheek of the speaker. Although the instrument is sensitive to these vibrations, it will not respond to air waves, and consequently noise emanating from a machine or other source near the speaker is excluded. Speech alone is transmitted to the distant end of the line. Experience gained since the Laryngaphone was

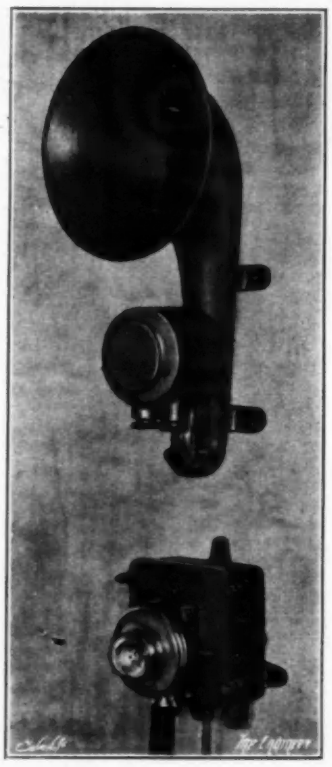


FIG. 55—LOUD-SPEAKING TELEPHONE—TELEPHONE MFG. CO.

first placed on the market in 1919 is said to have enabled the makers to produce a microphone which not only excludes extraneous sounds, but which transmits speech distinctly. The Laryngaphone has been incorporated in various instruments designed for use in engine-rooms, on the decks of ships, in machine shops, and in power stations, &c. To enable visitors to test the claims made for this instrument, a cabinet has been erected on the stand, and within this cabinet provision is made for creating a large amount of noise, which makes it impossible for an ordinary telephone to be used, although by means of Laryngaphones a conversation can be carried on with ease. A new model of loud-speaking telephone exhibited—see Fig. 55—is designed for the purpose of passing orders from the bridge of a ship to those associated with control work, with docking, cargo, and similar work on deck. The voice transmission is said to be sharp, clearly articulated, and loud, and individual voices can easily be recognised. The same microphone can be used as a fixture or as a hand set, thus allowing the operator considerable radius of action. One microphone can be used to operate a number of speakers at different points, separately or simultaneously.

LAURENCE SCOTT AND ELECTROMOTORS, LTD.

Examples of electrical machinery for use on board ship are to be seen on the stand of Laurence Scott and Electromotors, Ltd., of Norwich. Besides the well-known "Scott" worm geared electric winches, the firm is exhibiting, among other things, its latest self-contained contactor controlled winches, a new motor generator type, giving very delicate control for the handling of special cargo, and an electric worm geared boat winch. The standard Scott electric winch is controlled by a small handle to be seen in Fig. 56. All loads above 10 cwt. are lowered by releasing the magnetic brake by the hand release, which is also illustrated. The small controller handle operates the contactors, which are usually placed in the cast iron bed-plate of the winch, but if desired they may be placed in a deck-house. Instead of the control levers being arranged as shown, they may be combined so that a single lever serves the purposes of the two levers to be seen in the illustration. In order that the operator may not damage the control gear by careless operation, the controller handle is suitably interlocked with the contactors, and is controlled by patented timing elements. No harm is done to the control gear if the operator passes quickly through the full load lowering to full load lifting position, or *vice versâ*. It is claimed by the makers that no other control gear is so safe in the hands of unskilled

FIG. 56—ELECTRIC WINCH—LAURENCE SCOTT

operators. The speed of cutting out resistance is independent of the operator, and is fixed at the highest possible value, a scheme which gives much quicker working than that obtainable when the operator has to be taught to move the handle slowly. The load discriminator increases the speed of lifting for light loads and light hook. The speed load curve—Fig. 57—shows the speed of the firm's "No. 3 B" winch at all loads. The speed with a load of 3 tons, it will be perceived, is 100ft. per minute, but for normal loads the winch controller can be made so

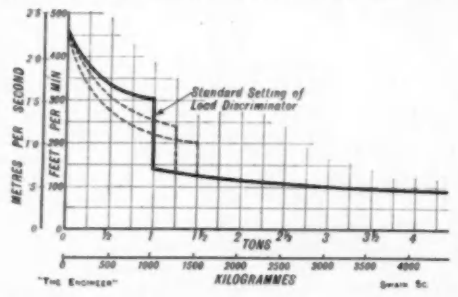


FIG. 57—SPEED-LOAD CURVE FOR ELECTRIC WINCH

that the automatic speed change occurs at any load desired between 1 ton and 1½ ton, according to the shipowner's requirements. The cutting out of resistance is done automatically, and it does not matter how quickly the operator moves the control handle hard over in either direction. One of the unique features of the winch is the braking gear, which comprises three distinct brakes—magnetic disc, centrifugal, and foot-operated brakes—all enclosed and protected from rain and sea water. The magnetically operated disc brake is completely released

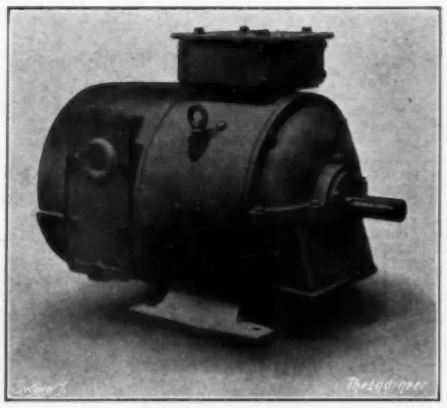


FIG. 58—MARINE TYPE ELECTRIC MOTOR—LAURENCE SCOTT

whenever the current is on, and it has a hand release lever by which it can be partially or wholly taken off for lowering heavy and medium loads. Both light and heavy loads can be let down at full speed and landed gently. The centrifugal brake is set for the maximum safe lowering speed, and makes it impossible for this speed to be exceeded, thus giving the operator the confidence which is essential for quick working. Besides forming an emergency brake, which also inspires confidence, the foot-operated brake enables a slow speed and even a creeping speed to be obtained, either during lifting or lowering with the current on, a feature which is essential for breaking out cargo from under the hatches and for preventing chuck on the slings. The centrifugal brake provides a purely mechanical means of preventing excessive speed, and is simple, reliable, and easy to adjust. At the light hook speed the Ferodo-covered blocks are quite free, but they rub slightly at 10 per cent. above that speed, whilst another 10 per cent. rise in speed gives sufficient friction to absorb the power of the maximum rated load of the winch when the load is falling at 20 per cent. above the light hook speed. Any higher speed than that the load cannot possibly reach. The lowering of all but the lightest loads is done by the hand release lever, which gives full control of the lowering speed, but without the centrifugal brake full advantage of this could not be taken safely.

The marine type motor—Fig. 58—another exhibit of Laurence Scott and Electromotors, Ltd., has been designed for driving ship's auxiliaries. These motors, which are made in horizontal and vertical patterns, are constructed on very different lines to standard motors as employed on land. Special insulation is employed that will withstand the conditions of marine service. The internal ventilating arrangements, we are told, ensure that the windings do not depreciate as the result of oil and dust being deposited on them. Another feature is that the frame is split horizontally, so that the machines can be opened up for inspection, cleaning and revarnishing with minimum trouble and expense.

REAVELL AND CO., LTD.

An important exhibit on the stand of Reavell and Co., Ltd., of Ipswich, is a two-crank, three-stage, marine type air compressor with a designed output of 300 cubic feet of free air per minute at a pressure of 1000 lb. per square inch. This unit is noteworthy as it represents the makers' latest design for this important class of machinery, which forms an essential part of the auxiliary equipment of nearly all motor vessels. In re-designing this series of compressors it has been sought to obtain a compact unit with the maximum amount of accessibility. The reciprocating parts follow in the main high-speed steam engine practice, and generous bearing surfaces have been provided. It will be seen from the sectional drawing Fig. 60 that while a trunk guide is employed to take the connecting-rod thrust, piston-rods and

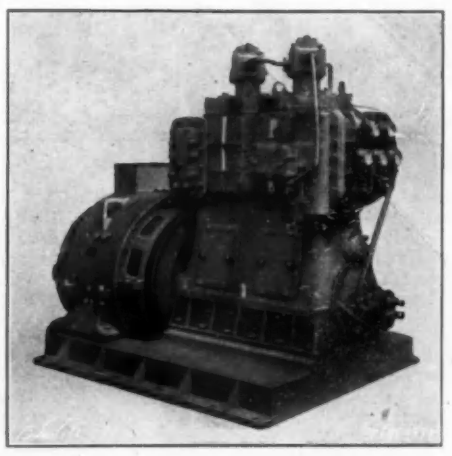


FIG. 59—AIR COMPRESSOR—REAVELL

glands are done away with. The piston casting to which the guide is attached forms the intermediate-pressure and low-pressure pistons, and attached to it is the high-pressure piston, which runs in a renewable liner. All the pistons are furnished with cast iron piston rings. The design is such that a complete line of parts can be withdrawn by lifting the main cylinder cover and removing the big-end bolts. By adopting such an arrangement the necessity of removing the cylinder casing from the bed-plate is avoided and the overhauling time is reduced to a minimum. The cylinder casings are provided with large cooling spaces and inspection doors on all sides, through which any sludge can be removed. The reciprocating parts are lubricated under forced feed by a valveless oil pump placed within the bed-plate and driven from the crank shaft. The cylinders, on the other hand, are each served by adjustable feeds from a mechanically operated lubricator. When desired, a special direct-driven circulating pump can be fitted.

Other features of the new design concern the valves and intercoolers. As the sectional arrangement shows, all the valves can be readily examined without disturbing any other parts of the compressor or dismantling any pipe connections. The valves are of the featherweight plate type with a low lift, which, the makers claim, gives quiet running and long service. Both the intercooler and the high-pressure after-cooler are of the straight-tube type. In the case of the first and second stage intercoolers, both are built in a single unit, which can be taken out bodily from the cylinder jacket for cleaning purposes. If desirable, spare intercooler units can be carried on board and fitted into place in a very short time. The

high-pressure after-cooler is shown to the right in Fig. 60, and it will be seen that when the unit is detached from the main cylinder a large opening is exposed, through which the tubes can be closely examined and, if found necessary, de-scaled. In order to protect the body of the after-cooler, in the event of an air leak causing a high pressure within the casing, a spring-loaded bursting disc of large diameter is fitted to the casing. In Fig. 59 we show a general view of one of the twin-crank marine type air compressors above described, which is mounted on the motor bed-plate. The motor has a designed output of about 140 B.H.P. and runs at a speed of 450 r.p.m. Other compressors exhibited include starting and injection air charging compressors for Diesel engines for working pressures of 450 lb. and 1000 lb. per square inch and hand and belt-driven machines. A two-stage air compressor designed for an output of 400 cubic feet of free air per minute at a pressure of 120 lb. per square inch, complete with its intercooler, is also shown, as well as compressors of the firm's "Quadruplex" type. A large portion of the machinery on the stand forms part of a range of ships' deck auxiliaries, such as winches, windlasses, capstans and steering gears worked by compressed air, which are demonstrated in operation. These have been specially designed for use on motor yachts, tugs and coasting vessels on which steam is not available.

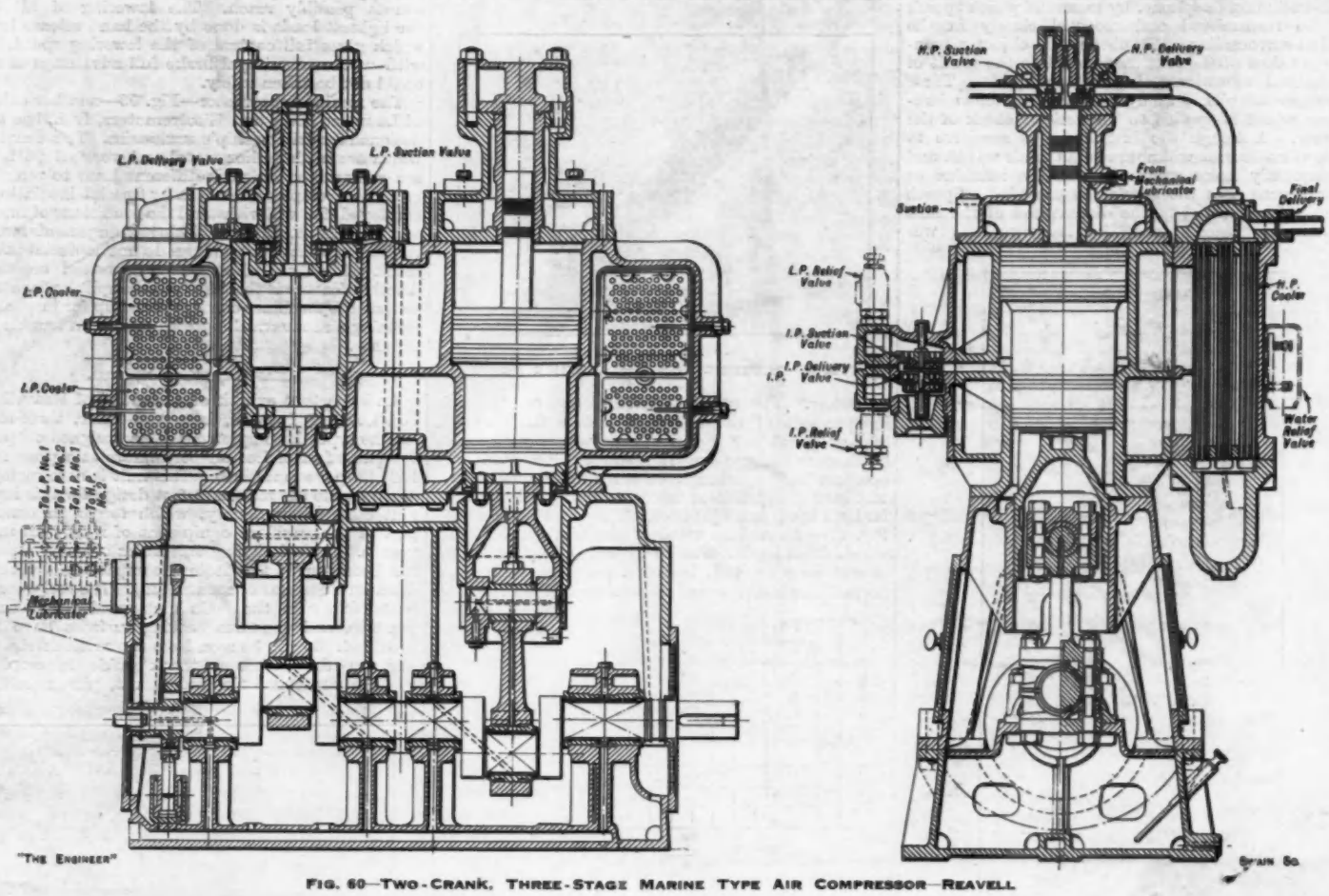


FIG. 60—TWO-CRANK, THREE-STAGE MARINE TYPE AIR COMPRESSOR—REAVELL

An exhibit which is of unusual technical interest, also shown on Messrs. Reavell's stand, is the new "Stancliffe" oil cooler—illustrated in Fig. 61. This is shown in the form of a demonstration unit having seven tubes 3ft. in length and a designed heating surface of 7ft. The cooler is mounted on a tank steadily falls as the film increases its thickness.

In the new "Stancliffe" oil cooler the inventor overcomes this inherent defect in the ordinary oil cooler by continuously wiping the inner surface of the tube by mechanical means. In Fig. 61 we show a section through the cooler unit demonstrated at Olympia. It will be seen that in general design the cooler follows accepted practice in that the tubes are held between tube plates, with ordinary water cooling. The oil enters at the left-hand end, and passing through the head enters seven tubes, in which are fitted rotors driven from the spindle. As the section in the centre of Fig. 61 shows, through each of the cooling tubes there is threaded a hexagonal rod with slightly rounded corners to the flats of which are secured a series of flexible blades or wipers made of phosphor bronze or steel strip, which exert a slight pressure on the surface of the tube, thereby continually wiping the surface and removing the oil film. It is claimed that with such mechanical action the heat transfer per square foot of cooling surface per deg. Fah. is increased by approximately five times, that the efficiency of the cooler is constant, and that in the case of fuel oils no sludge is deposited. Experimental results show that the rate of heat transfer per square foot per deg. Fah. is the same for all points on the viscosity curve and for all temperatures.

In an actual test made with a 1¼in. diameter tube, 3ft. long, the temperature of the oil was reduced from 156·6 deg. Fah. to 85 deg. Fah. at the rate of 6½ lb. per minute, and from 151·5 deg. Fah. to 51·4 deg. Fah. at the rate of 2·8 lb. per minute, with a cooling water inlet temperature of 45 deg. Fah. It is claimed that the system we have described enables the temperature of the oil to be brought down to within 8 to 10 deg. of that of the cooling water.

With this system it is possible, it is claimed, to reduce the size of the cooler for a given output to one-third that normally required and the weight to about one-half that of a cooler of normal design.

Messrs. Reavell have recently constructed a "Stancliffe" oil cooler for the British Admiralty, which was designed for dealing with 1000 gallons of lubricating oil per minute, and to cool it from 150 deg. Fah. to 80 deg. Fah. with cooling water at 65 deg. In this cooler the oil supply pump is integral with the rotor drive. The same principle can be applied, we learn, to evaporators and other appliances used in the chemical industry in which fluids having a low rate of heat transfer are treated. Although the cooler we have described is manufactured by Reavell and Co., Ltd., and exhibited on the firm's stand, all inquiries relative to it and its developments should be addressed to Mr. C. W. Stancliffe, consulting engineer, Astor House, Aldwych, London, W.C. 2.

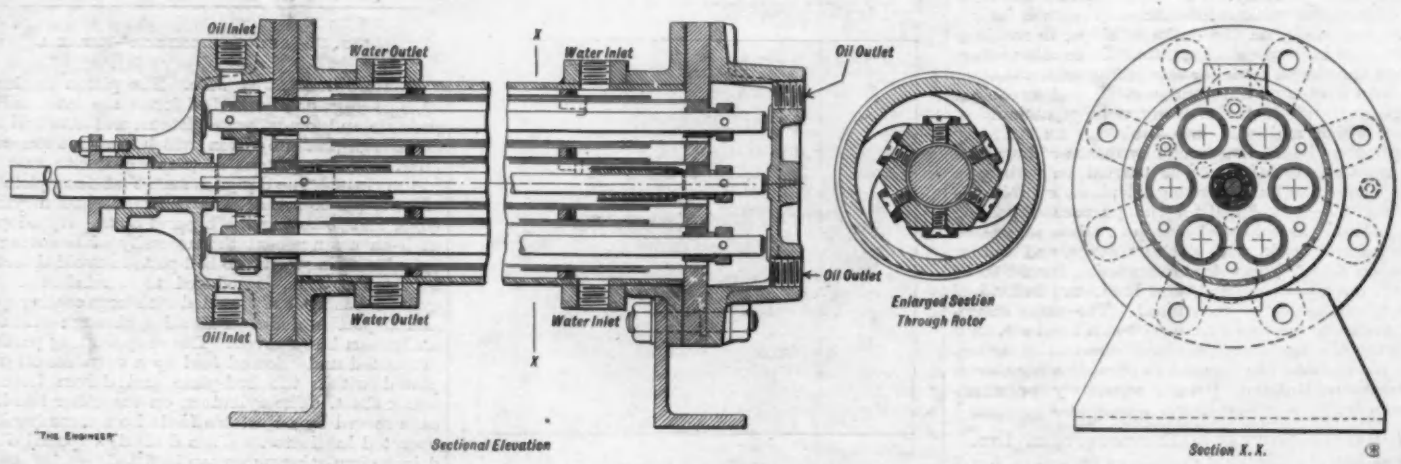


FIG. 61—STANCLIFFE OIL COOLER—REAVELL